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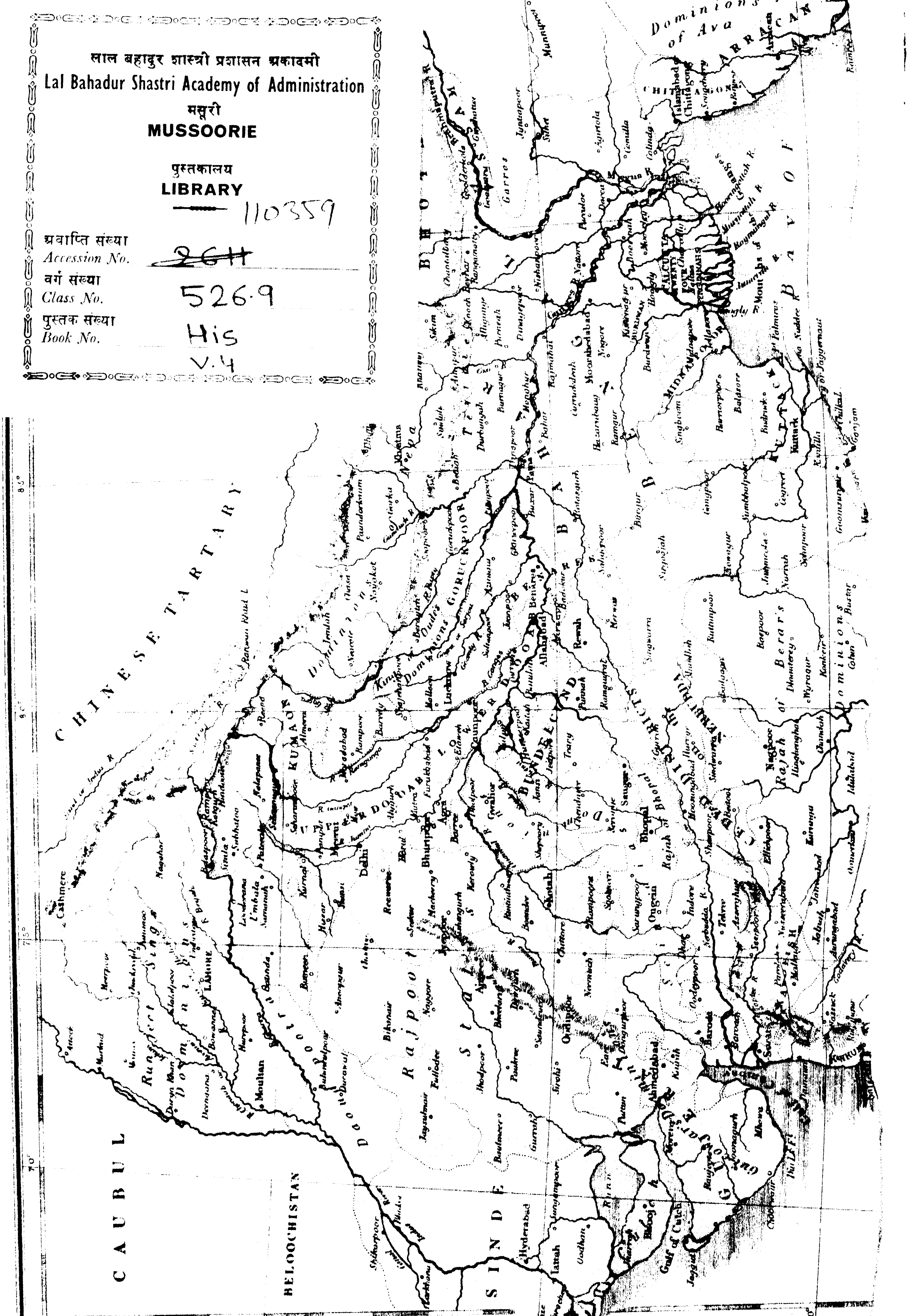

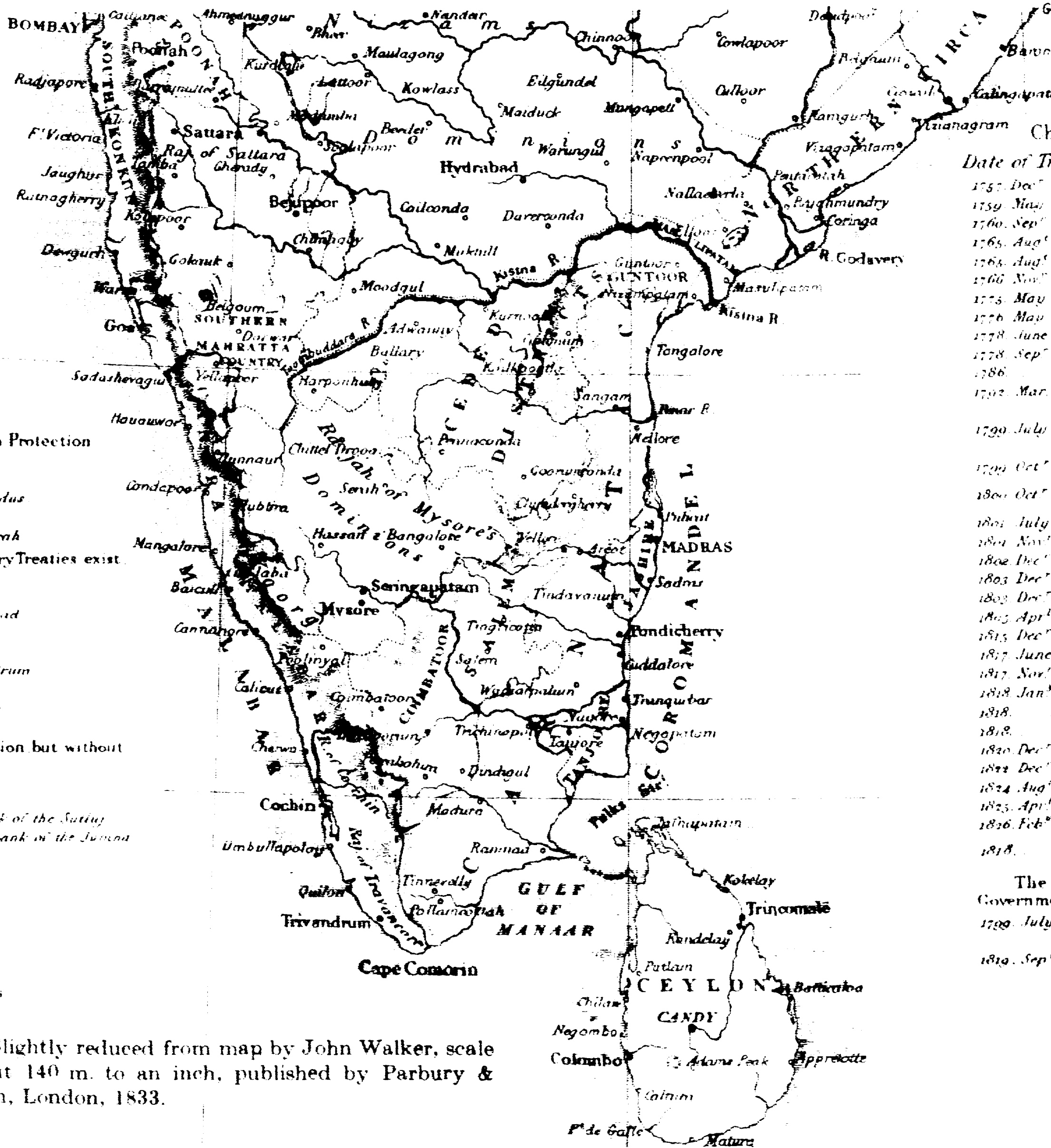

Slightly reduced from map by John Walker, scale about 140 m. to an inch, published by Parbury & Allen, London, 1833.

Chronological Table of the Acquisitions of the British in India.

Date of Treaty.	Districts.	From whom acquired.
1757. Decr 20th	Twenty four Pergunnahs	Nabob of Bengal.
1759. May 14th	Masulipatam &c.	The Nizam
1760. Sepr 27th	Burdwan. Midnapoor. and Chittagong	Nabob of Bengal
1765. Augt 12th	Bengal. Bahar &c	The Mogul
1765. Augt 30th	Company's Jaghire in the Vicinity of Madras	Nabob of Arcot.
1766. Novr 12th	Northern Circars	The Nizam.
1775. May 21st	Zemindary of Benares	Vizier of Oude.
1776. May 22nd	Island of Salsette	Mahrattas.
1778. June 17th	Nagore	Rajah of Tanjore.
1778. Sepr 18th	Guntoor Circar	The Nizam
1786.	Pulo Penang	King of Queda.
1792. Mar. 17th	Malabar. Dindigul. Salem. Baramahl &c.	Tippoo Sultaun of Mysore
1799. July 13th	Coimbatoor. Canara. Wynaad. &c.	Conquered from Tippoo Sultaun & ceded to the British by the partition Treaty of Mysore.
1799. Octr 25th	Tanjore	Rajah of Tanjore.
1800. Octr 12th	Districts acquired by the Nizam from Tippoo Sultaun in 1792 & 1799.	The Nizam.
1801. July 31st	Carnatic	Nabob of the Carnatic
1801. Novr 10th	Goruckpoor. Lower Dooab. Bareilly &c.	The Vizier of Oude.
1802. Decr 31st	Districts in Bundelcund	Peishwah.
1803. Decr 17th	Kuttack & Balasore	Rajah of Berar.
1803. Decr 30th	Upper Part of the Dooab. Delhi Territory &c	Dowlat Rao Scindia.
1805. Aprl 21st	Districts in Guzerat	Guicowar.
1815. Decr 2nd	Kumaon & Part of the Terraie	Nepal
1817. June 13th	Saugur & Huttah. Darwar &c.	Peishwah.
1817. Novr 6th	Ahmedabad Farm	Guicowar.
1818. Jany 6th	Kandeish &c.	Holcar.
1818.	Ajmere	Dowlut Rao Scindia.
1818.	Poonah Konkun. Southn Mahratta Country &c	Conquered from the Peishwah.
1820. Decr 17th	Lands in Southern Konkun	Rajah of Sawuntwarree.
1822. Decr 12th	Districts in Beejapoor & Ahmednuggur	The Nisam.
1824. Augt 2nd	Singapoor	Rajah of Johore.
1825. Aprl 9th	Malacca	Dutch.
1826. Febr 24th	Assam. Arracan. Tavoi. Ye. Tennasserim. &c.	King of Ava.
1818.	Districts on the Nerbudda. Sumbhulpoor. Patna &c.	Rajah of Berar.

The undermentioned Native States have been established by the British Government, in a part of the Territory which had been acquired by right of conquest.

1799. July 3rd	The Rajah of Mysore a descendant of the Antient Rajah's of the Country	In a part of the Territory acquired from Tippoo Sultaun.
1819. Sepr 25th	The Rajah of Suttarah the Antient head of the Mahrattas	In a part of the Territory acquired from the late Peishwah

State Pensioners.

The King of Delhi
Nabob of Bengal
Nabob of the Carnatic
Rajah of Tanjore
The Peishwah
The Princes of the House of Tippoo &c

Native States not under British Protection

Nepal
Lahore (Subject to Runjeet Sing)
Chiefs of Sinde at the Mouth of the Indus
Scindia.
Rajah of Dholpoor. Baree & Rajahkairah

Native States with which Subsidiary Treaties exist.

King of Oude.	
The Bhoonslah or Rajah of Nagpoor.	
The Nizam whose capital is Hydrabad	
Holcar	*Indore*
Mysore	*Mysore*
Travancore.	*Trivandrum*
Cochin	*Cochin*
The Guicowar	*Baroda*
Cutch	*Bhooj*

Native States under British Protection but without Subsidiary Treaties.

Bhopal
Sikim.
The Sikh & Hill States on the left bank of the Sutluj
The Jaut & other States on the right bank of the Jumna
The Boondela States
Rewah
States of Rajpootana
States of Malwah
States of Guzerat
States on the Malabar Coast
States on the Burmese Frontier

Foreign Independent States

China
Cochin China
Siam
Ava
Caubul
Persia
Muscat.

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92

HISTORICAL RECORDS OF THE SURVEY OF INDIA

1830 to 1843

GEORGE EVEREST

VOLUME I	18th Century	Published 1945.
VOLUME II	1800–15	,, 1950.
VOLUME III	1815–30	,, 1954.
VOLUME V	1844–61 : Andrew Waugh	In Press.

VOLUME IV

GEORGE EVEREST

Published 1958

PRINTED IN INDIA

HISTORICAL RECORDS OF THE SURVEY OF INDIA

Volume IV
1830 to 1843
GEORGE EVEREST

Collected and compiled by
Colonel R. H. PHILLIMORE, C.I.E., D.S.O.,
(late Royal Engineers and Survey of India)

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1958

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V.4

90

THE WISDOM OF GEORGE EVEREST

All human works are liable to error, and it is only in the power of man to guard against its intrusion by care and attention [108].

That which is used for a basis of other operations ought to be itself as free from error as instrumental means and human care can make it. ... One of the greatest evils...is the liability to make mistakes, from which no human being can hope to be exempt [10].

Where errors combine instead of compensating, we learn... the true value of prudence and a rigorous attention to accuracy in principle as well as practice [101].

To take that which is defective as a test of that which is perfect is manifestly...illogical. An agreement between the computed and measured bases...proves nothing whatever, for such coincidences are the merest matters of accident, and... often...occur where the connecting triangulation has been replete with faults [17].

I was resolved to improve the survey and tolerate no inferiority in the execution. ... If I have any reason to suspect any defect in the instrument, or any instability in the platform, or any want of precision in the signal observed, or even if...the angles...presented any discrepanies for which I could not account, I...reject the whole set bodily, and replace it by an entirely new set of angles taken under circumstances free from objection [90].

I have little time for discussion, ... particularly for those questions which have over and over again been sifted, examined, and settled [259].

That the whole of India will be eventually covered with triangles may be looked for as a result almost as certain as any future event can be. ...

Here closes my long and laborious undertaking in which, though from first to last I have necessarily gone through much hardship and privation, yet these have not been without many alternations of gratification and amusement [22].

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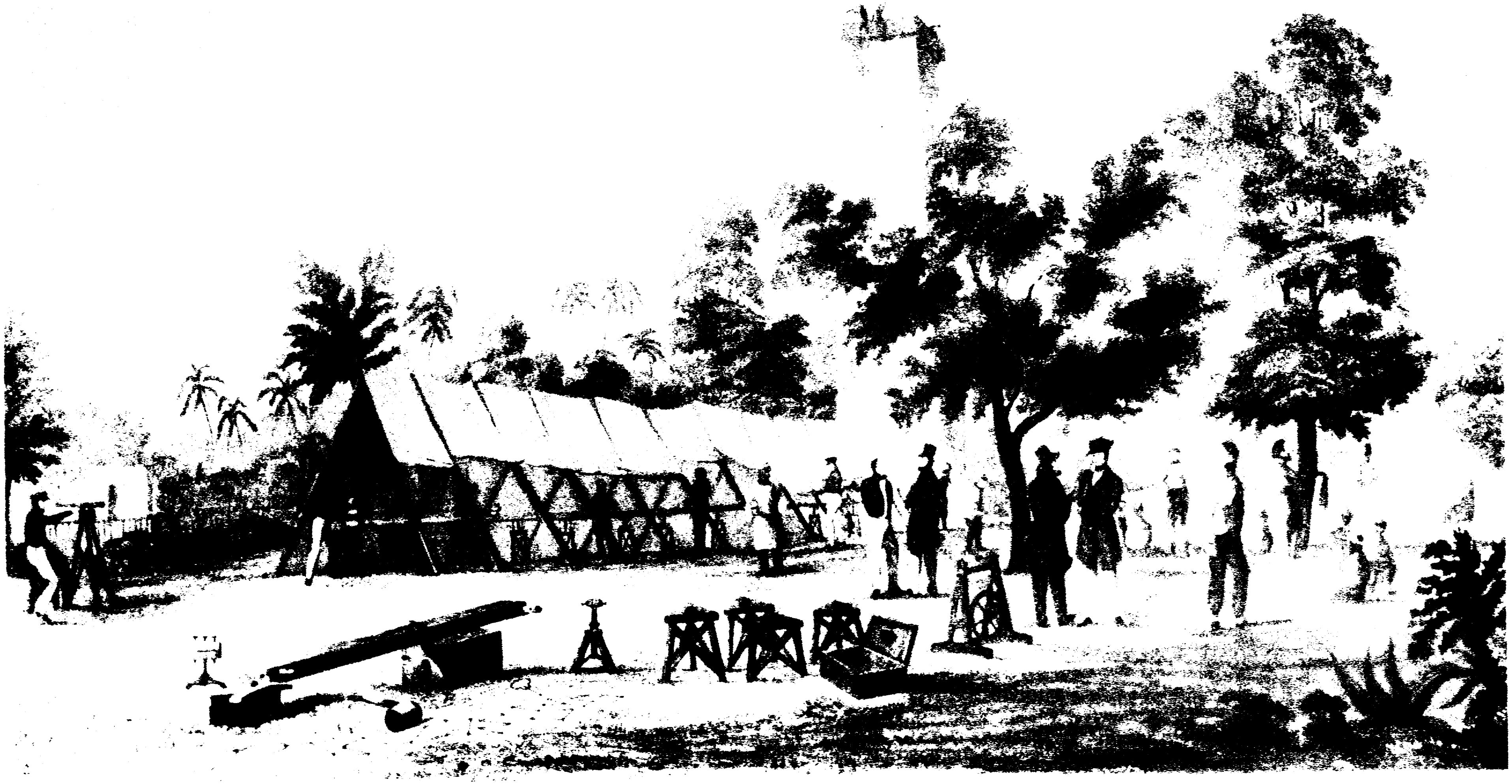

CALCUTTA BASE LINE

from a sketch by James Prinsep, Jany. 1832
[III. 405 : IV, ch. iv].

Reg No 5521 HD'52-800 54

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ADDENDA & CORRIGENDA, VOL. I

Supplementary to lists on pp. vi and 305 of that volume, pp. v to xiii of Vol. II, and p. v of Vol. III.

Page xx *against* Seton Kerr, *delete* lines 2 and 3, *and substitute* Vol. I, 1784–88, by Seton Kerr, 1866; Vols. II to V, 1788 to 1823, by Sandeman, 1868.

27 lines 8 and 15, *for refs.* 3 *and* 4 *read* 1 *and* 2 *and at* end of section, *after* Bettiah *insert ref.* 3, *adding note* 3, svys. by De Gloss, MRIO. 56 (45, 57) (20).

line 4 from bottom, *for ref.* 3 *read* 4 *and renumber note.*

32 line 7 from bottom, *after* 1772 *insert ref.* 8 *with note,* MRIO. 51 (5), 59 (40), Balasore & Midnapore, with roads by Adams, 1768–9, and Carter, 1771–2.

51 shift ref. 8 to end of previous para. *after* Bengal ; at end of note 8 *add* MRIO. Misc. holds photo-stats of two maps presented by T. R. Munro, 1889 ; 1st., ' The Town of Calcutta ', bearing legend ' within the compass of these palisades live the Europeans and Christians ', and shewing English, Armenian, and Portuguese churches, and view from river with refs. a to z ; 2nd., the 1753 "Plan of Fort William", by Wm. Wells.

These reproduce original MS. plans in King Geo. III's colln., BM. K. Topo. CXV (41, 42).

54 at end of note 2 *add* ; ib. Misc. 3–O–1779, new works by Lt.Col. Watson, CE., survd. April–May 1779 by Robinson, 200 ft. to inch.

at end of note 5 *add* ; also MRIO. 1–O–1793, by Upjohn, 2–8–1794 ; photo-zincd. SGO. Calcutta, with Well's map as inset, Sept. 1890.

58 at end of note 1, further to addm. [III, v], *add* MRIO. Misc., Part of Oude, with marches of Dett. comdd., by M Gen. Robt. Stuart, March–May 1799 ; Goruckpore to Maundi and S. to Cawnpore, Thos. Wood, 8 m. to inch.

at end of note 13, *add* ; MRIO. Misc., Lalldang to Hardwar, Wood, Jan. 1800, 2½ inches to mile.

120 note 4, *add* ; cf. *Indian Arch.* III, 1949 (127).

125 at end of note 4, *add* ; MRIO. Misc. old ser. V-269-g-4, Tillicherry and the island of Darmapatam...during siege, 1779–81.

Page

at end of note 7, *add* ; MRIO. Misc. old ser. V-269-g-1, Mangalore Fort taken by army under Gen. Mathews, 9–3–1783 ; besieged by Nabob May to July 1784 ; survd. by Chas. Reynolds.

128 last line, *after* 1791 *insert ref.* 10 *to new note* MRIO. Misc., 1–O–1791 ; Dhārwār Ft. surrendered, 4–4–1791, to force under Sartorius ; survd., by C. Hempel, Sgt. 75th Ft.

225 at end of note 1, further to addm. [II, vii], *add* ; incl. MRIO. Misc., 1/2–O–1779 ; 11–O–1814 ; 3–O–37 ; 164–O–73.

325 *under* CAMERON *for* Novil *read* Neville *and, line* 2, *for* 1755 *read* 1–9–1754, *and after* Bath *insert* MI. St. Saviour's Ch.

338 col. 1, under GOLDINGHAM below line 8 *insert new line,* FRS., FRAS., *RAS* (*mm*), X (80).

under GOMONDE, as new line at foot of col. *insert* Sold at Sotheby's, London, 25–11–57, two miniatures by John Smart of Maj., & Mrs. Gomonde of Madras, sd. 1790, for £ 310 and 480.

352 *under* MACLEOD, *line* 10, *after* DNB. *insert* , Portrait by Colosworthy Grant.

364 col. 1, line 14 from bottom, *after* Chittagong *change* ref. 9 to 8, and at end of note 8 *after* Dalrymple *add* ; *IO Cat.* (555/86–9).

370 at end of 7 *add* : *IO Cat.* (556/121).

386 at end of note 6 *add* : *IO. Cat.* (555 / 79–80), Wm. Stevens, Coringa Harbour, 1773 ; Rameswaram channel, 1781.

398 at end of note 7 *add* MRIO. Misc. old ser. V, 243, g.o., Plan of Tripatore, 4 m. N. of Ft. St. George, by T. Wood, drawn by J. L. Caldwell ; also Plan of Ft. St. George & environs, shewing Trivatoor, St. Thomé old castle and Mount to south.

ADDENDA & CORRIGENDA, VOL. II

Supplementary to lists on p. xiii of Vol. II, and pp. v to vii of Vol. III.

Page xi against p. 384, *under* SMITH *for line 6* Birth...unknown. *substitute* d. Tewkesbury, 6–11–1796, aged 60 ; MI. Abbey chyd. also records death of his wife Mary, 12–11–1787, aged 45.

Possibly son of John S. Smith of Old Meldrum, Aberdeen, and ed. Marischal Coll. 1761–5.

After return from India appd., before March 1780, Rector of Birts Morton, Worcs., some 5 m. W. of Tewkesbury where he settled. Also curate of Ashchurch, some 8 m. to SE.

Bennett's *History of Tewkesbury* (371–3) ; *The Vale Churchman*, Tewkesbury, Christmas 1954.

17 at end of note 3, *add* MRIO. Misc., 8–O–16, Part of Sundarbans, 4 m. to inch, survd. 1811–4 by Wm. Morrieson.

19 line 20, *for* now Bānkura *read* now Mānbhūm and part of Bānkura.

23 at end of note 9, *add* MRIO. Misc. old ser. IV-499-C-1, Town & Ft. of Kuttack, captured 14–10–1803, survd. by Blunt.

33 at end of note 6, *add* MRIO. Misc., 14–O–34, Colebrooke's marches, Oudh & Rohilkhand, compiled 1834 from orgl. plots.

97 at end of note 2, *add* MRIO. Misc., Sketch of Maratha Dist. Soondoor, 12 m. to inch, 24–9–1810.

98 at end of note 8, *add* MRIO. Misc. old ser. XII. 81 (a), E. 9, Plan of Heeroor Cusba, Chittal Droog, 1801 ; autog. James Ross ; ib. 3–O–1801, Boundaries Chitaldroug–Tumkur, Sept.–Nov. 1801.

103 at end of note 4, *add* MRIO. Misc. old ser. XII-81-E.g, Mysore Forts.

126 note 4, *after* Pondicherry, *for* 58 M/13 *read* & environs, 4 inches to mile, MRIO. Misc., 1–O–1791.

150 note 7, *after* Hemphel had *insert* survd. Dhārwār Ft. 1791, MRIO. Misc., 1–O–1791, and

Page

165 at end of note 4, *add* Cowper's route svy. to Delhi, MRIO. Misc., 1 & 2–O–51.

264 at end of note 3, *add* MRIO. Misc., 1–O–18, Lambton's Trig. Svy., 1800–18, scale 48 m. to inch, coloured to show reports in various vols. of *As R.*

280 at end of note 1, *add* MRIO. Misc., 1–O–15, Map of Malwa, Khandesh, & Central India, scale 16 m. to inch, from plan in GG.'s office.

313 at end of note 5, *add* ; cf. Seton Kerr, IV (459–539).

320 at end of 1st para, *after* England *insert ref. to new note* MRIO. Misc., 1–O–11, Isle de France, by Capt. Lisle Geoffroy ; autog. Robt. Smith.

429 *under* MAXFIELD *insert new line 2 to read* d. 1–1–37 aged 55.

438 col. 1, line 7, *after* 1825 *insert* ; Led mission to Sind, 1831.

col. 2, *under* RAVENSHAW, *line* 2, *before* bapt. *insert* b. 5–1–; *and for* 5–1–25 *read* 5–2–25.

442 col. 2, under SMITH Robt., *above last line* Leave to Cape *insert new para.* In 1828 designed and built new cupola for Qutb Minār to replace that destroyed by earthquake 1803. This was later removed to the ground as unsuitable. Smith also added balustrades for three lowest storeys. *add ref. to new note, v. Historic Delhi*, Bullock, 1951 (11) ; *Statesman, New Delhi Notebook*, 15–10–1956.

450 at end of note 11, *add* MRIO. Misc. S–20–B ; Seringapatam Ft. survd. by Norris & Warren.

467 *against Hemphel, after* dmn. *insert* formerly Sgt. HM. 75th Ft.

468 *against* Jungle Mehāls *for* Bānkura *read* Mānbhūm.

469 *against* Logarithms *for* 126 *read* 128.

ADDENDA & CORRIGENDA, VOL. III

Supplementary to list on p. xvii of Vol. III

Page iv reverse of Title Page, at end of last para. *for* 339 *read* 399.

xix line 1 of heading, *for* contents *read* contains

col. 1, *against* Anne Deane *for* thorough *read* through.

against *Aux. Tables* for *Departmental Auxiliary Tables* read *Tables to facilitate the Computations of a Trigonometrical Survey* and *for* Survey of India *read* Chief Computer.

against *Ben/Supply/Regr.* line 2, after *dency* enter full stop and change *Survey Committee* to roman type.

against Blunt, *line 3, for* 1811 *read* 1911.

col. 2, *against* Cardew *for* H. G. *read* F. G.

xx col. 1, against *Elephant Bill* delete (?)

12 last para of section SUNDARBANS line 2, *for* or Mānbhūm *read* later Bānkura and Mānbhūm.

15 at end of note 1, *add* Map of Damoda R., MRIO. Misc. old ser. III-2-A-r-, i, pr. survd. by Forbes.

17 at end of note 8, *add* ; Misc., 12–O–18, Town of Cuttack and vicinity, 4 inches to mile.

19 note 14, *after* maps, *enter* by Boileau, *and at end of note add* 8-m. reduction of whole, 18–O–17.

28 at end of note 2, *add* ; maps, 56 (9–12).

44 note 1, *before* dated *insert* letter *and after* 23 *insert* map sd. 21st July.

46 at end of note 4, *add* ; Skeleton trig. chart showing heights of 25 snow peaks, MRIO. Misc., 6–O–21.

56 at end of note 8, *add*, and Atlas sheet 129.

77 line 2 from bottom, *for* 134th *read* 13th.

80 at end of note 10, *add* ; ib. Misc., 4–O–24.

94 line 6, *for* 382 *read* 283.

97 at end of note 6, *add* ; Mudagiri Ft., 8 inches to m., MRIO. Misc. old ser. IV-44-E-1.

98 note 2, *for* 2 *read* 1 & 2.

99 at end of note 3, *add* ; ib. Misc., 15–O–34.

101 insert new note 3 to correspond with ref. 3, line 4 of para 3, *to read* MRIO. Misc. old ser. V-127-G-H, scale 5 inches to mile, by Summers, early 1818.

at end of para 3, insert ref 4, and adjust later refs. and notes.

128 at end of note 6, *add* with autog.

130 at end of note 9, *add* ; TS. 8/2 (2–3).

139 note 5, *for* Map *read* Maps *and at end of note add* ; 8–O–36.

152 at end of note 8, *add* Wroughton's svy. of disputed land on Gandak R., MRIO. 57 (23–4).

188 note 8, *for* W. R. *read* W. N.

208 line 22 from bottom, *for* 119 *read* 109.

236 line 10, *for* fifteen *read* eighteen.

259 at end of note 6 add ; *RAS* (mn), v (240).

269 at end of note 5, *add* ; and cf. Barnard's signals, 1767 [I: 311].

271 note 4, *before* copies *insert* sketch of telegraph line Ft. Wm. to Bānkura, MRIO. 51 (15).

272 at end of note 9, *add* ; in 1853 Mgte. was refused permission to demolish the Bargachi tower and use the bricks for road-making ; DDn. 563 (158), 21–12–53.

275 at end of 4th para from bottom, *for* 277–8 *read* 287–8.

284 footnotes, line 2, *for* Montgomrie *read* Montgomerie.

293 *for note 6 substitute* under heading *Construction of the Graticule for a General Atlas of India* ; GBO Lib. H.q. 3.

312 at end of note 5, *add* ; amongst maps drawn by May v. MRIO. Misc., 5–O–17, dated 3–5–19.

353 at end of section GREAT TRIGONOMETRICAL SURVEY insert new para., type 11, *with footnote 5* ; Officers of the Great Trigonometrical Survey drew full pay throughout the year, without any cut for monsoon months [346].

insert new note 5, DDn. 265 (235), from SG. 23–7–31.

372 *against* SAXTON, *col. 5, for* Sgt. Maj. Saxton *read* Sgt. Maj. Benj. Saxton, who d., Ganjam, 14–12–11, aged 38.

Page

385 *against* LEIGH *enter ref. 1, to note reading* appn. for pension, DDn. 44 (247), 1–10–62, gives name James Leigh.

387 *against* SUNDT, *col. 2, enter* d. Porandur, 29–4–56, aged 68 ; MI. Wanowrie, Poona.

411 line 16, *for* premission *read* permission.

427 col. 1, line 3 from bottom *delete* Miss *and after* Jane *insert* dau. of Chas. *and after* Christiana *add*, of Acct. Gen.'s Dept.

col. 2, *under* BROWNE, Birnie, *for last line, substitute* Feb. 1833, 7 mo. leave to hills ; Sept. 1841 to regtl. duty.

448 col. 1, *under* FITZGERALD, *line 6 from end, after* Rowe *insert* ; also survd. bunds of Midnapore Dist.

col. 2, *under* FOSTER, *line 4, after* Foster *insert* of Wells, Somerset, *and line 2, after* 4–6–42, *add ref. to new note 6, to read* d. nr. Stratford-on-Avon, *v.* Conolly (105/60).

452 col. 2, last para. line 2, *for* 1833 *read* 1832, *and line 5*, after Peshawar *add*, which he reached in Dec. 1833.

453 col. 2, *under* GIBBINGS Robert, *last line, after* 1818–9, *insert* which Gibbings himself compiled.

458 *under* HERVEY, *line 10, for* Margaretta Adrians *read* Margaritta Adriana Giester.

under HODGES, line 6 *for* 9–3–39 *read* 9–3–38.

459 col. 1, *under* HODGSON *insert* new line 2 *to read* Ben. Inf. *and line 12 after* 61 *inside bracket add*, 232.

line 7, *for* Harriot *read* Harriott.

line 8, *add* ; their dau. Frances Anne m. Wm. Delafield Arnold, Ben. Inf., bro. of Matthew Arnold, poet.

462 *under* HORSBURGH *add* to last line ; *IO. Cat.* (578–85), volume of 126 charts by Dalrymple *&* Horsburgh *under* title *East India Pilot*.

col. 2, *under* IRVINE, *line 6 after* burgh *insert* ; and Elizabeth Little his wife, *and line 10, within brackets after* 528–9 *insert* ; 630 VV.

463 *under* JERVIS, line 13, *after* 1814 *add* ; visited Gulf of Cambay 1816 ; report on tides pub. *JRGS.*, VIII, 1838 (202–5).

464 *under* JOPP, *after line 9 ending* London *insert new line* to read *IO Cat.* (596), 19 water-colour views of African coast on one sheet.

467 note 1, *for* 1855 and 1856 *read* 1755 and 1756.

485 col. 2, line 15 from bottom *for* Yaltal *read* Baltal.

486 col. 1, at end of para 1, *after* himself, *insert* His route then took him up the Shyok and over the Karakoram Pass.

491 *under* OLLIVER, line 2 *insert* d. before 1858, *line 6, after* Cornelius *insert*—Joseph.

495 col. 1, at end of para 7 from bottom, *after* Maxwell *add* Eclipses obsd., *RAS* (*mn*), I (77, 119).

496 *under* RAVENSHAW,

line 1, after William *insert* [II, 438].

line 2, for bapt. 21–2–1781 *read* b. 5–1–1785.

line 3, for *Castell* read *Astell* and *for* 15 *read* 5.

under REES, *line 5, for* 1830–2 *read* 1831–2.

499 *under* ROBB, *line 5 from bottom for* 37 *read* 27.

under ROSS, Daniel,

line 8, delete BCS.

line 9, after Hamburg *insert* semi-colon.

lines 19–20, *after* Lambert *delete remainder of sentence, substituting* also served in IN. 1852–63.

note 4, *delete hyphen in name* Ross Seaton *and for* 2nd. *read* (1881–1955).

under ROSSENRODE, *line 3, for* 9–9–52 *read* 9–12–52.

500 *against* SANDYS *read* Frederick.

508 *under* Van HEYTHUYSEN,

line 8, *after* wife *add* ; half-bro. to G.E.W.D. van Heythuysen, also Mad, Inf.

line 9, for Marry *read* Mary *and for* Sich *read* Seck.

CONTINUED ON PAGE xiv

PREFACE

This fourth volume covers the years 1830 to 1843, during which that great geodesist George Everest held office as Surveyor General and Superintendent of the Great Trigonometrical Survey of India. He concentrated all his energies on the geodetic work.

Everest was great, not only as a practical geodesist who had a mastery of the theory and technical details of his profession, but also as a worker of determined character and drive. Having long experience of the country and a clear view of the task before him, he carried through his plans with resolution, and exacted work of the highest standard from his staff.

Though making no major contribution to the theories of geodesy as a science, he introduced important innovations in practical procedure in the field. Amongst these may be instanced the spacing of his triangulation into definite chains as bars of a gridiron—the observation of astronomical azimuths from pairs of circumpolar stars—the laying down of distant stations by ray-traces—and the deduction of astronomical arcs by simultaneous observation of identical stars with similar instruments at either end.

His first and most important task was the recruiting and training of officers and assistants of suitable qualifications and temperament. In this he had a constant struggle against sickness and disease, which not only led to continued wastage of skilled manpower, but repeatedly struck at his own person.

Though the science of geodesy has developed since his day, the principles which he enunciated—the methods he evolved—all of which he has recorded in full—cannot be too well known to working surveyors, and more especially to those who follow him in India. All the chapters in this volume on the trigonometrical survey and its staff belong to him. This full story of his work may well lead to a greater appreciation of its scientific value, and of the purpose of those rules and traditions that are still in force.

This volume also tells of the early revenue surveys of Lower Bengal, the North Western Provinces, and Bombay, and may be of great interest to those responsible for the assessment of land revenue. The technical problems here were elementary; the difficulties lay in co-operation between the professional surveyors and the civil settlement officers, and in control of the detailed measurements where the accuracy was under constant pressure from interested parties.

Of more general interest were the exploration surveys carried out by enterprising officers of all services. There were intrepid medical officers who penetrated the eastern borders and brought back sketches and routes from distant Burma. Beyond the western frontiers Burnes and Dr. Gerard made circuit through Afghānistān, Turkistān, and Persia, whilst the sailor John Wood penetrated to the source of the Oxus in the Great Pamīr.

Material for the story has been drawn from many sources, but the account of the trigonometrical surveys comes almost entirely from departmental correspondence of the period, which is in an excellent state of preservation, including even the stream of hasty notes which the great man poured out during the hectic months of his reconnaissance between Delhi and Dehra in 1833–4. There are also his lengthy periodical reports, and his final published account of 1847. Whilst the technical records and reports are still stored departmentally at Dehra Dūn, the correspondence volumes and the vast store of original maps have been transferred to the care of the National Archives at New Delhi.

For the revenue surveys original correspondence volumes were found in the local government record offices at Calcutta, Allahābād, and Bombay, from which selected extracts and reports have been published from time to time. Popular accounts have long been published of the more interesting geographical surveys.

Considerable space has been devoted to personnel. Trigonometrical and topographical surveys under the Surveyor General were administered by the Military Department of the supreme Government of India, the revenue surveys by the Boards of Revenue of the Presidency governments. Survey officers were still drawn from the Army, coming mostly from the artillery or infantry; engineer officers could seldom be spared from engineer duties.

Civilian assistants were mostly recruited as young schoolboys from East-Indians of mixed parentage or from Europeans. On the trigonometrical side, though a number of well-educated young Bengalis were employed as computers, only one of these, Radhanath Sickdhar, proved a useful field surveyor. On the revenue surveys, however, Indian surveyors were extensively employed.

Biographical notes are given for the senior surveyors and, following the lead of Sir Clements Markham, nominal rolls for the juniors. From friends in England portraits have been obtained of three 18th century surveyors, Reynolds, Topping, and Goldingham, and most interesting particulars of the Reverend William Smith, the surveyor of 1775, who held a living at Tewkesbury for the last years of his life. Many details of Everest's life have been drawn from an account written by his son especially for these records.

Everest insisted that "all human works are liable to error". It has been wrongly stated in chapter I that we numbered a son of a famous actress amongst our revenue surveyors. He was her grandson.

In preparing the chapters on the professional work of the Great Trigonometrical Survey, I have constantly kept in mind the great interest that Sir Sidney Burrard had taken in the start of these records, and I gratefully acknowledge the help given by Sir Gerald Lenox-Conyngham and Dr. de Graaff Hunter, who have both lamented that they had no such detailed account of Everest's work during their years in India.

I once again acknowledge the help and encouragement I have received from the Surveyor General and his officers and staff of the Map Publication and Geodetic Branches, and of the printing office of the Northern Circle of the Survey of India at Dehra Dūn.

DEHRA DŪN :
JANUARY 1958.

R. H. PHILLIMORE.

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ADDENDA & CORRIGENDA, VOL. III—(*concld. from p. vi*)

Page	
508	line 10, *after* Chiswick *insert new line to read* Hodson, IV (32, 638 RR).
517	*against* Arakan, *line 3, after* Myohaung, *for* 69 *read* 68.
518	*against* Bharatpur, *for* 18-126 *read* 18-1-26.
	against Bhils *omit* 425.
519	*against* Bradshaw *for* Parish *read* Paris.
522	*against* Dhaulagiri *before* 457 *insert* 48.
	against Drawing—PAPER, *line 13 from bottom, for* 108-9 *read* 109.
524	*against* Graham, *line 3, for* 372 *read* 371.
525	*against* Hodgson *for* Haughton *read* Houghton.
	against Izzat Ullah *for* 415-6 *read* 485-6.
526	*against* Jungle Mehāls *for* Bānkura *read* Mānbhūm.
	against La Place, *after* geodesist *insert RAS (mn)*, I(53).
527	*against* Lockwood, *for* 312-372 *read* 312, 372.
	for McCreedy (Creddie) *read* McReady (Reddie).
	col. 2, line 2, *for* 84 *read* 84-6.
528	*against* Moamarias *for* 339 *read* 399.
529	*against* Packing, *at end of line* add, *v.* Tin cases.
	against Rowe *delete* pl. 17n.
531	*against* Salt, line 2, *after* Calcutta *insert* 12-3.
	against Saxton, *at end of line add*, 360 n.1.
	against Scott, *for* Geo. H. *read* Geo. Hamilton (1815-43), *and line 3, for* b. 1812 *read* 1812-73.
532	*against* Spherical Excess, *for* 239 *read* 238 *and delete* 430.
533	*against* Taylor, *line 4, for* 1881 *read* 1781.
	against Telegraph, *line 1, after* 269-72, *insert* 442.

ADDENDA & CORRIGENDA, VOL. IV

Page	
8	line from 23 bottom, *after* Siddons *for* son *read* grandson.
45	in Chapter heading, *for Standard Rods* read *Standard Bars*.
61	note 6, *after* VII *insert* ; Syn. xiv.
63	note 1, *before* Comp. *insert* GBO.
74	notes, line 3, *for* longil. *and* Merdil. *read* longl. *and* Merdl.
112	line 4 from bottom, inside bracket, *for* II *read* III.
113	at end of note 6 add *Edin. Rev.* April 1848.
117	line 15 and p. 119 line 18, *for* Elliott *read* Elliot.
119	*under* TIDAL OBSERVATIONS, *para 4, line 2, for* 1835 *read* 1837.
139	line 11, *for* Gurmukhtesar *read* Garhmukhtesar.
247	line 16, *for* Hutton *read* Hulton.
	note 2, *after* VII *insert*, 1837 (102-13).
	note 3, *for* X *read* IX, 1839 (125-56).
	note 5, *for* L.R. *read* Sidney.
261	note 3, *for* (201) *read*, edn. 1844 (258).
262	line 8 from bottom, *for* Nagās *read* Nāgas.
420	*under* BEDFORD, *line 10 for* James B. *read* A. (Alexander ?), B.
492	*against* Triangulation *line 4* Secondary *after* 71 *insert* 108.

REFERENCES TO MS. RECORDS & OTHER ABBREVIATIONS

A/A G.	Assistant/Adjutant General
A D C.	Aide-de-Camp
A G G.	Agent to Governor General
A S G.	Assistant Surveyor General
B to CD.	Bengal Letter to Court of Directors
B C S.	Bengal Civil Service
B G O.	Bengal General Order
BM/Addl MS.	British Museum/Additional Manuscript
B M C.	Bengal Military Consultations
B P C.	Bengal Public Consultations
B Pol. C.	Bengal Political Consultations
B R C.	Bengal Revenue Consultations
B T C.	Bengal Territorial Consultations
Bd.	Board
Ben/Eccl.	Bengal/Ecclesiastical Records, C R O.
Biog.	Biograph/ical/y
Bo/C S.	Bombay/Civil Service
Bo/Pol/R/C.	Bombay/Political/Revenue/Consultations
Br/Assn.	British/Association for the Promotion of Science
C-in-C.	Commander-in-Chief
CD to B/Bo/M.	Court Letters to Bengal/Bombay/Madras
CD Misc.	Court Miscellanies, C R O.
C M.	Court Minutes, C R O.
C P.	Central Provinces
C R O.	Commonwealth Relations Office, London
Cert.	Certificate
cf.	compare
Ch/Sec.	Chief Secretary
Coll/r/g/n.	Coll/ege/ect/or/ing/ion
Com/Corr.	Committee/of Correspondence, C R O.
Comn/r.	Commission/er
Comp/n/r.	Comp/il/ut/ation/er
DDn/Mgte.	Dehra Dun/Survey Records now with NAI./ Magistrate's Records
D C.	Deputy Commissioner
DG/OS	Director General/Ordnance Survey, Gt. Britain
D L R.	Director of Land Records, West Bengal, rev. svy. records now with NAI.
D S G.	Deputy Surveyor General
Dep.	Deputy
Dept.	Department
Dist.	Dist/ance/rict
Div.	Division
E.	East
EI/C/Ho.	East India/Company/House
et seq.	and following
Exbt.	exhibit No.
Ex/Engr/Offr.	Executive/Engineer/Officer
Eur/Letters	Europe/an Regiment/Letters to Gen. Walker, STS. 1864–72; GBO Lib. Q. 68; old 7/33, DDn. 241
F D.	Foreign Department
Fdbk.	Fieldbook
Fin.	Financ/e/ial
Ft/Wm.	Fort/William
GBO/Comp/Lib.	Geodetic Branch / Computing Office / Library/ Dehra Dun
GG/in C.	Governor General/in Council
G of I.	Government of India
G O.	General Order
G T S.	Great Trigonometrical Survey of India
Gt Arc.	Great Arc of Meridian, GTS.
Gen.	General/Department
Gov/r/t.	Govern/or/ment
H M S.	His Majesty's Ship/Home Miscellaneous Series, C R O.
H S.	Hill Station, G T S.
H of C.	House of Commons, London
I O/Maps/Rec.	India Office/Maps/Records/now C R O.
ib.	the same.
Inf.	Infantry
inf.	below
Jud.	Judicial
L F E.	Typescript biog. of Geo. Everest by Lancelot Feilding Everest

L G.	Lieutenant Governor
L P.	Lower Provinces, Bengal
M.	Memoirs or Journals, Survey of India
M C S.	Madras Civil Service
M Gen.	Major General
M G O.	Madras General Order
MI/M/O.	Mathematical Instrument/Maker/Office
M M C.	Madras Military Consultations
M R I O.	Map Record & Issue Office, Survey of India; maps now with N A I.
M R O.	Madras Record Office, Egmore
M S.	Manuscript/Military Secretary
Mad.	Madras
Mdpn.	Midshipman
Mgte.	Magistrate
Mar.	Marine
Math/l/n/s.	Mathematic/al/ian/s
Memo.	Memorandum
Mil.	Military
Misc/LR.	Miscellaneous/Letters Received, C R O.
N/E/W.	North/East/West
N A I.	National Archives of India, New Delhi
N W P.	North Western Provinces of Bengal
n.	footnote
Narr.	Narrative Report attached to Report, 1836
O S.	Ordnance Survey of Great Britain
P A.	Personal Assistant/Political Agent
P W D.	Public Works Department
para.	paragraph
passim	here and there
Pol.	Political
Presd/t/cy.	Presiden/t/cy
Progs.	Proceedings
Provs.	Provinces
Pub/n.	Publi/shed/cation
Q M G.	Quartermaster General
qv.	which/whom/see
ref.	reference
Regn.	Regulation
Res/d/n.	Res/ign/ed/ation/olution
Report, 1836	SG.'s Report to Mil. Dept., 30–8–36; DDn. 286 (276–374)
Report/3–8–39/ 21–8–39	SG.'s Reports, DDn. 344 (91–184/195–254)
Report, 1842	SG.'s Report, 13–8–42; DDn. 402 (298–368)
Rev.	Revenue/Reverend/Review
Rev Bd/LP/WP.	Proceedings of Sadr Board of Revenue/Lower Provs., Ft. Wm./West. Provs., Allahabad
S/E/W.	South/East/West
SG/O.	Surveyor General of India/Office at Calcutta
S of I.	Survey of India
S O.	Settlement Officer
S S I.	Secretary of State for India, London
S T S.	Superintendent of Trigonometrical Survey
sd.	signed
Sec/tt.	Secretar/y/iat
sic.	thus; as printed
Stokes' Sch, Regr.	ms. Register of Stokes' School, Mussoorie, now with Geneol. Soc., London.
Subdn.	Subdivision
sup.	above
Survey Rolls	Service Rolls of Survey Staff; G B O Lib.
T S.	MS. Professional Report/Tower Station/GTS.
Ter Dept.	Territorial Department
U P.	Upper Provinces, Bengal
V M.	Victoria Memorial Hall, Calcutta
V P/in C.	Vice-President/in Council/Bengal
v.	see
viz.	that is to say
W.	West
W P.	Western Provinces of Bengal

Dates: 22nd Aug. 1837 or 22–8–37. **Editorial Insertion**: [...].
Number of page, consultation, or paragraph: (286).
Reference to page/plate/of this volume: [286]/[pl. 8]: of earlier volumes [I: 215] / [III, 418; pl. 12].

FURTHER ABBREVIATIONS: page 414

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Bo Sel.	*Selections from Bombay Government Records.* Bombay. occasional.
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Cal Rev.	*Calcutta Review.* periodical.
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CHAPTER I

GENERAL NARRATIVE

Notable Events — Great Trigonometrical Survey — Great Arc — Subordinate Triangulation — Revenue Surveys ; North-Western Provinces — Lower Provinces — Bombay — Geographical Surveys — Conclusion.

THIS volume covers the period from October 1830, when Everest took office as Surveyor General of India and Superintendent of the Great Trigonometrical Survey, to December 1843, when he handed over to Waugh, who had been his able and loyal assistant for eleven years.

For the first five years Lord William Bentinck was Governor General, and under instructions from London introduced considerable reforms and economies into the administration of the country. Whilst with the aid of a Deputy he also held office as Governor of Bengal, the upper, or western, provinces were entrusted to a Lieutenant Governor from 1834, and reconstituted as the North-Western Provinces the following year with headquarters at Agra[1].

Disregarding unpopularity with the services, he enforced the strictest economy in their privileges. He took vigorous action to improve the administration and collection of land revenues, and a special interest in the revenue settlement of the Upper Provinces. He presided at a conference of revenue officers and surveyors at Allahābād in January 1833, which effected a great acceleration of the surveys and reduction of their costs.

Great strides were made in the construction of roads in all directions under the new Public Works Department, and substantial progress in extending canals to the west of the Jumna and through the upper *doāb* and Rohilkhand. Bentinck further gave every encouragement to the work of the Great Trigonometrical Survey, which he realized was essential to the provision of adequate surveys and maps.

Cordial relations were maintained with Ranjīt Singh, the vigorous and capable ruler of the Sikhs, and officers were encouraged to travel in Afghānistān and Turkistān, to gain knowledge of their geography and political relations.

It was Lord Auckland who, from 1837, was responsible for the disastrous policy of interfering in the internal affairs of Afghānistān, and of restoring the exile Shāh Shuja to the throne of Kābul in place of Dost Muhammad. Under treaty with Ranjīt Singh, the British "army of the Indus" crossed that river at Sukkur and, marching through the Bolān Pass and Kandahār, occupied Kābul in August 1839. Two years later the Afghāns rose, murdered Shāh Shuja and the leading British officers in Kābul, and utterly destroyed the retreating army in January 1842. Pollock's "avenging army" reached Kābul by the Khyber in November to round up and withdraw surviving British detachments[2]. After the occupation of Sind for the passage of troops to Kandahār, that country was annexed in March 1843.

Though the Afghān war was a very great strain on the army and the finances of India, it hardly affected the Great Trigonometrical Survey. It occasioned, however, the recall of a number of military officers from the revenue surveys, and gave opportunity for a wide extension of geographical knowledge of countries beyond the north-west frontiers.

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[1] Sir Chas. Metcalfe became LG. at Allahābād 14-11-34 ; then acted as GG. on Bentinck's departure, 19-3-35 ; he assumed office as LG. of NWP. at Agra, 28-3-36, after Lord Auckland's arrival.

[2] Lord Auckland recalled 1841 ; succeeded as GG. by Lord Ellenborough, who was himself recalled 1844.

GREAT TRIGONOMETRICAL SURVEY

The year 1830 opened a new epoch in the history of Indian surveys, an epoch that had to await the man. Everest had served his apprenticeship under the devoted Lambton, and had then spent two arduous years extending the great central chain of triangles through the wildest part of the Deccan, working out new ideas and practical devices that might tend to the perfection of this brave measurement.

Forced by the break-down of his health to spend the next five years in England, he devoted himself to the study and mastery of all geodetic work that was then going on in Europe, and to the design and construction of scientific apparatus that should best suit Indian conditions. With a sure hold on essential principles, he was not afraid to break away from previous routine in his determination to cut out every possible source of error.

Whilst in England he persuaded the Court of Directors to give first priority to the extension of the great meridional arc from Central India, where he had left it in 1825, to the Himālaya Mountains. This involved carrying the principal triangles across the great Jumna–Ganges plain, long considered an almost insuperable barrier, and making special astronomical observations at the terminal stations of the main sections. Other chains of triangles were to be observed on a systematic plan that should eventually cover the whole of the Company's territories and the friendly States. No attempt was to be made to organize new topographical or geographical surveys until a framework of principal triangles was ready.

He procured new instruments—compensation bars for measurement of base-lines—theodolites for triangulation—astronomical circles for observing arcs of amplitude—heliotropes and reverberatory lamps for signals. Equally important was the engagement of a skilled instrument maker, Henry Barrow, in whose workshop at Calcutta all repairs and reconstruction could be promptly effected, instead of being left undone, or delayed by despatch to England and back.

Though the Great Trigonometrical Survey was to absorb practically the whole of his attention, Everest was as Surveyor General responsible for all other surveys. At the time of his return in 1830 the small establishment of the Trigonometrical Survey working under Joseph Olliver was but one of many survey units at work. In Madras there was a Deputy Surveyor General with a drawing office and three topographical parties. In Bombay the Deputy Surveyor General had a drawing office and a few unimportant local surveys, whilst Shortrede had started a trigonometrical survey intended to cover the whole presidency; the local government was experimenting with their own system of revenue survey. Both these Deputies were abolished in 1833, leaving the Surveyor General directly responsible for work in both presidencies.

In Bengal there were but two topographical surveys in progress—that of the lower Brahmaputra under Wilcox, and that of Bharatpur under Boileau. There were transfrontier surveys under the Quartermaster General in Central India and Rajputāna, and under the political department in the north-east. A number of surveyors were employed on large-scale revenue surveys in Assam, the Sundarbans, and in the upper provinces from Gorakhpur to Delhi.

Everest's immediate problem was a working plan for the trigonometrical survey, and the recruitment, organization, and training, of a staff to carry out that plan.

The first task was the completion of Olliver's longitudinal series and the measurement of a base-line near Calcutta on which it should be closed. Then followed the extension of the Great Arc from Sironj, about 150 miles south of Gwalior, to the Himālayan foot-hills in the neighbourhood of Dehra Dūn, and the measurement there of another base-line. The remeasurement of the base-line at Sironj became essential, for the measurement made with the old chains in 1825 could not balance those measured with the new compensation bars.

Whilst the Great Arc furnished the backbone of the whole system, the subordinate chains of triangles had to be of such accuracy that the intervals could later be filled without risk of error by topographical surveyors working with cheaper instruments. For the sake of systematic technical control and economical working, these triangles were to be arranged in meridional series about one degree apart, tied by longitudinal series at convenient intervals. To provide for the early incorporation of existing maps of Bengal into the quarter-inch Atlas of India, start was to be made eastward from the Great Arc, running meridional chains northwards to the Himālaya from Olliver's longitudinal series.

For all this work Everest planned for two field parties to work on the Great Arc—one under his personal charge—and six subordinate meridional series; eight parties in all. His first task, therefore, was to find officers of suitable ability and character whom he could train in the shortest possible time to take independent charge of these highly technical operations. He himself had gained his experience in many years of hard practical work and study; how could he impart that experience to his new officers? And where should he find them? Olliver and his three assistants were not fit for independent charges of this nature.

Wilcox and Boileau were drawn from topographical surveys, Macdonald from revenue survey. Of Engineer officers who had been through a short course with the trigonometrical survey of Ireland, Waugh and Renny were both to prove geodetic surveyors of the highest class.

A number of country-born or European assistants had to be found with sufficient mathematical education and understanding. Of those recruited in the first two or three years, Logan, Murphy, Armstrong and James proved fit for independent charge of field parties before Everest left India.

There was less difficulty in collecting reliable *khalāsis* and *lascars* for the management of tents and camp equipment, lamps, heliotropes, and other signals, and in the multifarious duties attendant on field surveys.

The Mathematical Instrument Maker had to be established in Calcutta with skilled workmen and suitable tools. A sufficiency of instruments had to be collected to supplement those brought from England, and this entailed much ingenious reconstruction of old stock. Mohsin Husain, "the artist" from Arcot, was taken into the field to deal with emergency repairs.

To the correspondence and drawing offices that already existed Everest added a computing office, for which he engaged well-educated Bengalis with a natural flair for such work, placing them under charge of Joshua De Penning, who had worked under Lambton for 23 years, and was now called up from Madras to be tower of strength so long as Everest remained in India.

Everest spent two years in Calcutta, fully occupied with the organization of his new department, the measurement of the Calcutta base-line, the comparison of the measuring apparatus against new standard bars, and the preparation of instruments and equipment for the field.

After reconnaissance of the surrounding country the base-line was measured in January 1832 along the Barrackpore trunk road, two 75-foot towers being specially built as terminals near the 5th and 11th milestones where they stand to this day. The connection to Olliver's longitudinal triangles was concluded in June 1832.

In January 1832, after assisting on the base-line, James Western, a young engineer officer, was sent out with the first field party to run the Parasnāth series south into Orissa to connect up Buxton's survey of Cuttack. After Western had struggled with little effect for more than two years Everest decided that he had no aptitude for the work and dispensed with his services. Bridgman died after a few months, and was followed by Boileau. After much delay the series was closed down in 1839. The results were not good enough for geodetic purposes.

A second party under Macdonald was formed to start the most westerly of the meridional series from Budhon near Saugor. Macdonald made good progress till his health broke down in 1835, when he left the survey and died in Edinburgh two years later. The series was completed during 1838.

The Ranghir and Amua series, to the east of Budhon, were taken up in October 1833 by Waugh and Renny after a few months' instruction. Waugh was repeatedly called away for work on the Great Arc, and in his absence the Ranghir series was left to his senior assistant till its completion in 1842. No further series could be taken up at this time for lack of officers.

When Everest took over control of the Bombay triangulation, he found Shortrede's work by no means up to standard. Shortrede was slow to follow instructions, and was diverted to other work, and it was not until Jacob took over in 1835 that work on the Bombay Longitudinal Series was started on sound methods, and brought to a satisfactory close in 1842.

GREAT ARC

Everest had obtained sanction for two field parties to work on the Great Arc and meant to devote his whole energies to this work. His first task was a careful personal reconnaissance of the whole line, of which nothing was known except that it would pass near Agra, and would have to cross the great Jumna-Ganges *doāb*.

In December 1832 he sent out a party under William Rossenrode, one of Lambton's old assistants, with instructions to run an approximate series northwards towards Agra, selecting suitable stations. This task had been allotted to Boileau earlier in the year, but he had no idea of how such work should be done, and accomplished nothing of the slightest value. Olliver was now deputed to join Boileau at Agra and reconnoitre the country southwards from Delhi.

By the end of the year Everest was at last ready to leave Calcutta himself. He sent his field office by boat up the Ganges and on to Mussoorie, where he intended to establish his headquarters. Meanwhile, with Wilcox, he visited Macdonald near Saugor and Rossenrode south of Gwalior. Travelling north along the intended line of the Great Arc, he dropped Wilcox at Agra, picked up Boileau and Olliver, and made a general reconnaissance right through to Mussoorie.

He thus gained a clear idea of the nature of the task, and time to make preparations for the next working season. Wilcox was to collect stores, equipment, and transport at Muttra, and to make up portable scaffolding and masts for the detailed reconnaissance, and Government was asked to sanction the erection of high masonry towers across the plain from Delhi to the Siwālik range.

In November 1833 he reconnoitred the country between the Dūn and Sahāranpur, and selected a stretch of ground 5 to 10 miles west of Dehra as suitable for a base-line. He then marched straight through to meet Wilcox at Muttra and make final arrangements for the season's work. Wilcox was to work southwards to link up with Rossenrode's approximate series which had barely reached the neighbourhood of Gwalior, even though work had continued into September.

Everest himself, with Boileau, Olliver, Rossenrode, and several of the younger men, laid out the triangles northwards from the neighbourhood of Fatehpur Sikri, west of Agra. On his west, or left, flank the selection of suitable stations on hilly ground presented little difficulty until he reached Delhi, where much time was spent searching for rays visible through the dense smoke-laden atmosphere before a good view was found from an ancient building on the historic ridge. Great difficulty was found, however, along the centre and east flank in the search for mutually visible stations and well-shaped triangles. Between Muttra and the hills some 200 miles to the north 14 towers had to be constructed, and were only just ready for observation by the end of 1835.

The problem to be solved was by no means simple. The Jumna valley was practically dead flat, except for a few low mounds that were seldom at convenient situations. The plain was densely covered with towns, villages, and clusters of trees, and it was difficult to get a clear line of sight of even five miles. There was no detailed map with any pretension to accuracy.

Everest had devised portable masts by which blue lights could be shown at a height up to 90 feet above the ground, whilst he was himself perched with his theodolite on a thirty-foot scaffold. He planned to manœuvre these by trial and error to get well-shaped triangles of intervisible rays, with sides of about 25 miles. Blue lights were the most brilliant for work at such distances, but only burnt for a few minutes at a time. Programmes worked out for the observer at the theodolite and the signaller with the lights were constantly interrupted by stormy or hazy weather, and it was often difficult to decide whether failure to see a light was due to faulty signalling or the intervention of an obstruction. It often happened that one or more of the sites first chosen had to be shifted.

As work proceeded he devised a more rapid and reliable procedure. This "ray-trace" system proved of the utmost value, not only in the later stages of the Great Arc, but also on other series running across similar country. After some difficulty he found suitable stations along the broken crest of the Siwālik range, which gave good connection with his base-line and the terminal station Banog, a 7,429 feet peak near Mussoorie. He completed his task—completely exhausted—in time to take up quarters in Mussoorie in May 1834.

Season 1834–5 was devoted to the measurement of the base-line in the Dun, and its connection to the main triangles.

After a serious illness which lasted several months, Everest resumed the field in October 1835, taking the precaution of having Waugh with him, and the two of them observed all the triangles southward to the neighbourhood of Gwalior that season, and right through to Sironj during 1836–7. The vertical angles across the Jumna plain were left for Waugh to carry out during May and June 1837.

His original programme being now thrown out by trouble with the astronomical circles, Everest decided to re-observe the whole triangulation between Sironj and Bīdar, and remeasure the Bīdar base. He had always been doubtful of the accuracy of the section from Bīdar to Pilkher carried out by Lambton's assistants, and felt that it would also be well to re-observe his own work of 1823–5, so that the section Bīdar to Sironj should be of the same high standard as that just completed. Abandoning the base-line and astronomical observations of 1824 at Tākarkhera, would thus divide the Great Arc into two sections of triangulation proved by the three bases, Bīdar, Sironj, Dehra Dūn—and corresponding with two astronomical arcs of amplitude, Damargida-Kaliānpur, and Kaliānpur-Kaliāna. Both sections would be of uniform quality throughout, and he would be able to leave India with the knowledge that, so far as he was concerned, the foundation of the survey of India had been well and truly laid.

With full confidence in his judgement the Government of India gave their consent, though the remeasurement of the Bīdar base-line was referred home to the Directors. The re-observation of the triangles was carried out by Waugh and Renny during 1838 and 1839, and so pleased was Everest with the results that he actually proposed the revision of all Lambton's work right down to Cape Comorin. Government would not hear of this at the time, and the revision of these southern sections was not carried out till after 1866.

Everest had planned for special astronomical observations to be made simultaneously at Kaliānpur, near Sironj, and at Kaliāna, about 60 miles south of the Siwāliks, which was to be the north end of his arc. In April 1837 he set up the two astronomical circles that had been constructed by Troughton and Simms to his order, but to his horror he found that both instruments were top-heavy and ricketty. Boldly deciding to remedy the trouble locally, he sent for the Mathematical Instrument Maker from Calcutta, and Barrow arrived in time to start work at Kaliāna in October. New brass pillars were ordered from Fatehgarh, and iron base-plates and circles from Calcutta. Setting Barrow to work with artificers from his own field workshop and others borrowed from ordnance magazines, Everest hurried to Sironj, but having a severe return of fever had to leave the remeasurement of the base-line to Waugh.

On his return to Kaliāna he found that Barrow had made little progress on the circles and that the casting of the base-plates at Calcutta was not going well. His energy and drive soon got work going well, and he then took the circles up to Mussoorie where by the end of the rains their reconstruction was completed except for the division of the horizontal circles. Barrow then took them back to Kaliāna and spent two months in their erection and final adjustment. Everest was delighted to find that all unsteadiness had now been remedied, but disgusted at Barrow's refusal to divide the azimuth rings or carry out any further orders. He was therefore sent back to Calcutta, and there discharged.

Mohsin Husain, whose technique had greatly improved, was now entrusted with the very difficult task of dividing the circles. He carried this out with the greatest success at Mussoorie, under the close supervision of Everest, and both instruments were ready for service by October 1839.

Waugh took one circle down to Kaliānpur whilst Everest took the second to Kaliāna. Commencing from 4th December they made simultaneous observations of zenith distance on 48 consecutive nights. A similar programme was carried out during season 1840–1, with Waugh at Damargida, and Everest at Kaliānpur.

The new base-line at Bīdar was measured by Waugh between October and December 1841, and this completed all the field work of Everest's two sections of the Great Arc—from Bīdar in the Nizām's Territories, latitude 17° 55′, to Banog in the Himālaya, latitude 30° 29′—a direct distance of about 870 miles.

SUBORDINATE TRIANGULATION

As work on the Great Arc and the earlier subordinate series drew to a close, Everest had some difficulty in holding Government to the original programme. Owing to the difficulty of working the triangles across the plains the whole survey was costing more than had been expected. High cost had forbidden the construction of substantial masonry towers except on the Great Arc, and work elsewhere was carried on from low towers and mounds of sun-dried mud bricks, with the sides of triangles shortened to less than 15 miles.

Everest urged the importance of maintaining a high standard of accuracy, pointing to the error in Olliver's longitudinal series that had been revealed by the closing on the Calcutta base, but the Directors doubted the importance of such errors for the purpose of geography and map-making, and Government ordered that the spacing of future meridional series should, for reasons of economy, be spaced at two degrees apart instead of one.

Everest said he would obey orders if they were insisted on, but pointed out that though such errors might be permissible in a topographical map they should never be accepted for controlling triangles. He claimed that he had been commissioned to maintain the highest attainable standard of accuracy on the Great Trigonometrical Survey, and asked that reference should be made to the Directors. His arguments, were accepted and orders issued that the meridional series should continue at one degree interval as originally planned.

When he left India at the end of 1843, the meridional series, Budhon, Ranghir, and Amua, had been completed, whilst Karara, Chendwar and Gora, were in progress.

REVENUE SURVEYS: NORTH-WESTERN PROVINCES

When Hodgson started the revenue surveys of the upper provinces in 1822, he insisted on a standard of professional work that was far higher than the revenue officials really needed, and an accurate survey of topographical features that was of no value for the assessment of revenue. The consequence was that the military officers in executive charge were reluctant to delegate any major control work to their assistants, or to make adequate use of local Indian labour.

Though it was intended that the professional survey should run in close touch with the civil settlement staff, there was a tendency for the two operations to drift apart. Progress was far too slow for the needs of the administration, and the cost too heavy for revenues that depended on the survey for their expansion.

Up to 1830 some of these surveys had been administered from Fatehgarh under the Central Board of Revenue with the Commissioners of the Ceded and Conquered Provinces and others from Delhi under the Western Board. In 1831 both these Boards were superseded by the Sadr Board, Western Provinces, located at Allahābād, entirely independent of the Sadr Board at Calcutta.

Land revenue formed a very large proportion of Indian revenues, and it was widely recognized that much revenue, rightly due to Government, was never collected for lack of reliable records. It had long been accepted that the only system fair to Government and to individual *zamīndars* and cultivators was to base the settlements on accurate professional surveys, and without such surveys it was impossible to ascertain what land was still lying waste that might be brought into cultivation to become a source of revenue.

Bentinck, who had always taken a particular interest in maps and surveys of all descriptions, insisted that greater output must be got from the survey parties, and their work adapted more closely to the needs of the settlements. Foremost amongst his advisers were Merttins Bird and James Thomason, who had been much tantalized by the deliberate methods employed. A statement of the problems was circulated—a spate of technical reports flowed in—and the surveyors, especially William Brown, shewed every will to cooperate. The new system adopted at a conference held at Allahābād in January 1833 introduced revolutionary changes.

In future the professional surveyor was to hold charge of both the professional control survey and the detailed *khasrah*, or field survey and record of holdings. Village maps were to be plotted on scale of four inches to a mile, and reduced to one-inch or two-inch *pargana* maps, and again to ¼-inch district maps. Boundaries were to be settled beforehand by the revenue staff who were to be responsible for classification of soil and assessment of revenue. The surveyors gained the substantial advantage of being able to arrange for the control and detail surveys to follow each other closely under their own supervision.

The number of survey parties was increased from five to seven, and again to ten, and capable officers had to be found. Several were drawn from the Artillery, the best known being Henry Lawrence and James Abbott, but most of them were recalled to military duty during the Afghān war. Of the earlier stalwarts who stayed on, the more prominent were Bedford—who held charge as Deputy Surveyor General at Allahābād, in close touch with the Sadr Board of Revenue till his transfer to Calcutta at the end of 1837—Wroughton, who succeeded him as Deputy Surveyor General in 1844—and William Brown who finally reverted to military duty in 1844, and was killed on service the following year.

Under the new system the output for each survey rose to over a thousand square miles a year, but even this did not satisfy the revenue officers, who were anxious to complete their first long-term assessment as early as possible. Under the lead of Merttens Bird, a new procedure was introduced by which the annual output rose to over 3,000 square miles for each party. This was effected by cutting down professional work to a minimum, and leaving the survey of all interior detail to the *amīns*, or Indian measurers.

This change was introduced from 1837, and many of the settlement officers were shocked at the loss of accuracy that resulted. Bedford had from the start been strongly opposed to any relaxation of technical precision, and deeply offended when the change was introduced against his advice. He welcomed a transfer to Calcutta, where he combined professional charge of the revenue surveys of the Lower Provinces with charge of the Surveyor General's office at the Presidency.

The surveys now left under the immediate control of the Board of Revenue advanced so rapidly under the new procedure that—under the call for financial retrenchment that followed the Afghān war—all work in the North-Western Provinces was closed down by the end of 1842.

The speed-up of work by the methods introduced in 1833, and even more by the relaxation of close professional control from 1837, was no doubt expedient at the time, but resulted in little of long-term value, either for the provision of trustworthy settlement records, or for the effective mapping of the country, for which they long remained the only available material. When the next thirty-year settlement was taken up in 1871, survey was carried out entirely anew in the form of cadastral, or field-to-field, survey, on the scale of 16 inches to a mile.

REVENUE SURVEYS, LOWER PROVINCES

The revenue surveys of Assam, Sylhet, the Sundarbans, and the salt agencies of Noākhāli and Chittagong, had been proceeding independently for many years before 1830 under the local commissioners. Extensive surveys were not required as in the upper provinces, but only in such areas as were not covered by the permanent settlement of 1793.

After 1830 the surveys in Assam continued under civil surveyors, but operations were cramped from lack of funds, and were brought to a close during 1841–2, after the survey of areas suitable for tea cultivation.

The greater part of the cultivated areas of Sylhet had been surveyed between 1822 and 1830 under Thomas Fisher, and after his transfer to political duties work proceeded fitfully by *amīns* without professional control. In 1837 the regular survey of the newly ceded Jaintia territory was taken up by Henry Thuillier, and extended into Cāchār till work was brought to a close early in 1843.

After completing the main survey of the Sunderbans, Alexander Hodges carried survey into the salt agencies on the banks and islands of the Meghna which he completed by 1835. Changes were constantly occurring in the limits of cultivation along the Sundarbans border, by the reclamation of jungle by enterprising cultivators, or by the swamping of cultivation by vigorous jungle growth, and the Commissioner could never manage without one or more civilian surveyors.

There had also been changes in the Chittagong District, not only since the days of the permanent settlement, but even since Cheape's survey of 1814 to 1818, and in 1834 Henry Siddons, son of the famous actress, was appointed to make a more exact and thorough survey of cultivated lands, which continued till 1842. Though his survey shewed village lands and boundaries on the four-inch scale, the Commissioner insisted that the needs of the settlement officers would never be met until they were given reliable cadastral maps, field by field, on a very much larger scale. Financial restrictions made such a proposal altogether out of the question.

Though the Bihār districts had fallen under the permanent settlement, there were wide areas of waste land that were steadily being reclaimed. Desultory surveys carried out in the Santāl Parganas, Monghyr, and Bhāgalpur, were followed from 1835 by regular surveys that were extended into Purnea from 1840. At the end of that year two parties were transferred from the North-Western Provinces for survey in Patna and Gaya.

The permanent settlement had not affected Orissa, which was Marātha territory until 1803. Several proposals had been made for revenue surveys, but an experimental survey of Kharda between 1818 and 1820 showed that areas of cultivation were too small and scattered to be worth the expenditure. By 1837 there had been so much extension of cultivation that a detailed survey of the whole province was called for, as well as of such parts of Midnapore as had not come under permanent settlement. Four new parties were raised for Midnapore, Balasore, Cuttack and Puri, and this increase of work led the Board of Revenue at Fort William to obtain the services of Bedford from Allahābād as Superintendent of Revenue Surveys.

The standard of survey in the Lower Provinces was generally of a higher quality than that in the north-west. The surveyors were given full charge of both the professional control and the detailed *khasrah*, with adequate staff of assistants, Indian surveyors, and *amīns*. Heavy rains, close vegetation, and short duration of the working season, added to general unhealthiness, kept the annual output much lower than that of the western provinces and the cost-rates immensely higher.

Owing to the permanent settlement there was no local revenue staff as in the west, such as *patwaris*, *kānungos* and *mirdhas*, and much more responsibility fell on the professional surveyors, though special Deputy Collectors were appointed to settle boundaries in advance, and to apply legal pressure on *zamīndars* and local headmen when necessary. Here also the urgent need for financial retrenchment led to the premature closing of most of these surveys before 1843.

REVENUE SURVEYS, BOMBAY

Though there had been revenue surveys by Indian measurers at one time or another in Madras districts, there had never been any regular scientific surveys and it was not until 1857 that a survey of the lands of the whole presidency was put in hand on a cadastral system.

In Bombay, on the other hand, there had been the most minute and thorough survey of Bombay and Salsette carried out between 1807 and 1827, and of Gujarāt between 1812 and 1828. It was disappointing that the good work in Gujarāt was so little appreciated by the civil revenue officers and land-holders, who preferred to base their revenue assessments on the ancient and no longer trustworthy records of the Akbar period, in much the same way as was followed in Madras. Surveys of South Konkan though of considerable value for statistical purposes were not suitable for detailed assessments.

In the Deccan there were no records of any value except in Sātāra where the survey by Adams and Challen remained the standard for all assessments for several generations. In the Southern Marātha country, and in Poona, various district officials had endeavoured to effect surveys and settlements with Indian staff after the model of Munro's survey of the Ceded Districts of Madras, and in 1826 Robert Pringle had been put on special duty for the purpose. He brought his surveys and assessments to a close in 1831, but they were never adopted. The assessments were far too heavy and the surveys unreliable, and they were definitely abandoned after a rigorous examination by Shortrede.

From 1836 a regular survey was put in hand under George Wingate, of the Engineers, much on the lines of Munro's survey. There was no attempt to lay down scientific control by triangulation or traverse, but the large staff of Indian measurers was well organized, and closely checked and supervised under British military officers, so that the resulting field and village measurements gave excellent data for the assessment of revenue, though they were of no value for the compilation even of district maps. Wingate worked in the closest co-operation with the civil authorities, and was later appointed civil revenue commissioner.

GEOGRAPHICAL SURVEYS

During Everest's long visit to England between 1825 and 1830 he persuaded the authorities at India House that the trigonometrical survey should take priority over all other surveys in India. He returned, therefore, armed with full authority to devote his every attention, first to the completion of Lambton's Great Arc, and then to subsidiary triangulation on which future surveys should be based, and which would also tie up such old surveys as were fit for the quarter-inch Atlas. This was making steady progress in London under that great cartographer, John Walker. Everest was further armed with an order that, except for military or transfrontier surveys, none should in future rely on traverse or astronomical control alone. To this rule he adhered with persistence.

The three Madras parties continued their programmes, completing Ganjam and Nellore—Madura, Trichinopoly and Salem—and carrying on the survey of Hyderābād State, the Nizām's Dominions. The first two were broken up in 1844, but the vast area of Hyderābād was not completely covered till 1864. These surveys all followed the regular system laid down by Mackenzie, and fully maintained the high standard set by the earlier Madras surveyors.

An independent survey was started in the wild hilly tracts of western Ganjam during the military operations that broke out at the end of 1833. Thorold Hill and other Madras officers were engaged in these unhealthy tracts for the next eight years, and were frequently asked to assist in political matters. Thanks to his knowledge of the country gained on the survey, Macpherson was later placed on special duty for the suppression of the horrible practice of human sacrifices.

In Bengal proper there were few surveys beyond those carried out for roads, rivers, embankments, and canals, by officers of the Public Works. The survey of the Lower Brahmaputra started by Wilcox was carried on by Ommanney till the end of 1834, when it was closed down thirty miles short of Dacca. Everest pointed out that the survey was of no real mapping value as the river was continually changing course, and there was no early prospect of connection to the Great Trigonometrical Survey.

On the north-east frontier Robert Pemberton continued his explorations and surveys towards Manipur and the Burma frontier, and in 1835 he conducted a political mission into Bhutān which collected fresh knowledge of that mountainous country. There were various interesting journeys in different parts of Burma by enterprising officers of all services, including the doctors.

In Bombay the most important survey was that carried out between 1836 and 1839 by Henry Giberne in the little-known country of north-east Gujarāt, on the borders of Jodhpur and Udaipur.

It was about 1830 that attention was first called to the possibilities of navigating the Indus River, and early in 1831 Alexander Burnes made a pioneer journey up river to Lahore on a mission to Ranjīt Singh, taking with him a royal gift of five English horses. He then made a remarkable journey to Bukhāra in 1832, accompanied by James Gerard who, though in a shocking state of health, kept up a continuous survey from Herāt on the return journey. On Burnes' mission to Afghānistān in 1837 he was accompanied by John Wood of the Indian Navy who made a detailed survey of the Indus up to Attock, and later surveyed the Oxus to its northern source in the Pāmīrs.

Before Everest left England in 1830 the Directors asked him to take an interest in the geography beyond the north-west frontiers, and he had a map compiled in his Calcutta office of the country from the Punjab to the Caspian Sea, to which considerable material was added from exploration by Burnes and the many military officers employed on surveys during the Afghān campaigns. A preliminary map was published in 1838 by the able Frenchman Jean-Baptiste Tassin, who had set up a printing press in Calcutta. Much of the Surveyor General's printing work was handed out to private firms, and it was not until 1841 that a branch of the Government lithographic press was placed at his service. A departmental press was not established until 1852.

CONCLUSION

The survey epoch described in this volume is the most important in the history of the department, comparable to the early years of the century when Lambton was fighting to convince the masters of India of the necessity of his scientific survey, and when Mackenzie was insisting that good maps could only be produced by regular surveys on an orderly system. Everest's fight, in which he had the full support of the Directors in London, was to evolve a practical system of geodetic work of the highest accuracy, adapted to Indian conditions, that could be extended over the whole length and breadth of the peninsula. To effect this, and to ensure its future conduct after his departure, he had to build up an establishment of officers and men soaked in the principles that he had inculcated, with leaders of high talent and firm character, who would carry on the good work, adapting it to any new problems and preserving the same high standards.

During his first ten years Everest needed all his talents to overcome difficulties that had never been conceived of in England. Chief of these were the crossing of the Jumna-Ganges plain with its thickly populated, trèe-covered, smoke-obscured, flats, and the last-minute discovery of the unsteadiness of the two instruments with which his astronomical arcs were to be observed. In each case the remedy was only provided by his own imaginative genius which devised the plan of escape, and his indomitable will that forced a solution against all obstacles.

His undaunted force of character prevailed repeatedly against the impatience of a local Government that could hardly follow his lengthy technical dissertations. Government was all for speed and economy, Everest for the highest accuracy, having to justify one change of programme after another. Though his forceful language was occasionally resented, his professional knowledge commanded respect at all times, though he sometimes only prevailed by an appeal to London.

The making of new surveys without the control of the Great Trigonometrical Survey was anathema to him, but Lord Auckland was impatient for up-to-date maps and resented the absence of his Surveyor General from the Presidency. Finding that he could hardly call in the Superintendent of the Great Trigonometrical Survey during the most anxious stages of his most important work, he appointed a non-professional committee to conduct map-making policy at Calcutta. As might have been expected, this committee made the most astounding proposals, such as compilation of maps from worthless old surveys, without any regard to the regulations for the quarter-inch Atlas of India. The vigorous protests of Everest and his deputy Bedford were passed to London for orders, and the Directors replied without hesitation that responsibility for map-making rested with the Surveyor General and none other.

Perhaps the greatest struggle was that of his succession. He had been desperately ill both in 1835 and 1837, and, just as in 1824 and 1825, he wrote wildly about his fears, and the Directors concluded he was in danger of complete breakdown. Without consulting him, or even the Government of India, they appointed Thomas Jervis as "Provisional Surveyor General", to provide against possible eventualities. Everest was horrified when he heard of this, for he had the poorest opinion of the surveys which Jervis had carried out in the Bombay presidency, and no use for the pretty maps that had won the admiration of the Bombay Government and the authorities at home. He had the utmost contempt for the voluble address which Jervis delivered before the British Association in England. He condemned the maps officially, and unofficially tore the pretentious speech to shreds. He wrote no more of failing health, but insisted on his own personal control till the last details of the Great Arc were completed. After Jervis had retired in 1841, the succession of Andrew Waugh was assured.

When, therefore, he came to hand over office, Everest left a team well trained in practical methods of high precision suited to the difficult conditions of the country. He had triumphed over the formidable flats of the Ganges valley, and closed the grand chain of triangles, first conceived and started by Lambton, well and truly connected to its Himālayan terminal. He had obtained official acceptance of his system of triangulation and given it a substantial start. His crowning satisfaction was that he left a man after his own heart to continue the good work.

He closed his field office at Dehra Dūn in September 1843, handed over charge to Waugh in Calcutta, and sailed for England on the 16th December.

CHAPTER II

GREAT TRIGONOMETRICAL SURVEY: POLICY & PROGRAMME

Plan & Preparation, 1830–2 — Great Arc, 1833–41 — Subordinate Meridional Series, 1833–43.

GENERAL Walker[1] thus describes Everest's work in his account of the final adjustment of the Great Trigonometrical Survey published in 1870[2].

> The year 1830 marks a highly important epoch...in the history of this survey, for it was in that year that the several new instruments—great theodolites, astronomical circles, and the Colby base-line apparatus...—began to be received from England, where they had been constructed under the superintendence of Colonel Everest...with such care and skill that they are still scarcely surpassed by the best modern instruments [III, 195].
>
> With the new instrumental equipment new systems of observation and new methods of reduction were introduced. ... The work which was executed before the year 1830, though it is still of very great value for geographical and topographical purposes, ... has ceased to be of value for geodetic requirements, and has shared the fate of all similar operations which were executed contemporaneously in other parts of the world. ...
>
> The operations prior to the year 1830 may be briefly described as the construction of a net-work of triangulation over southern India...grounded on and verified by chain-measured base-lines [II, 258 ; III, 232]. Through the middle of the net-work a chain of principal triangles was carried in a meridional direction, the angles and base-lines of which were measured with greater care than was bestowed on the surrounding net-work, ... to obtain a determination of the figure of the earth...for the calculations of the latitudes and longitudes. ...
>
> Colonel Everest...introduced instead the—so-called—gridiron system[3], which consists of series or chains of triangles following certain obligatory meridians, and tied together at their extremities by others...generally following parallels of latitude. ... The meridional chains were intended to be placed at intervals of about 1° apart, while the longitudinal chains were to be carried along the parallels of Calcutta, Bombay, and Madras, which are about 6° apart.

On 8th October 1830 Everest resumed his appointment as Superintendent of the Great Trigonometrical Survey, after nearly five years absence. The remnants of the old establishment were employed under Olliver on the longitudinal series connecting Calcutta to the Great Arc, and Everest's immediate task was the measurement of a base-line of verification. After the necessary reconnaissance, and the collection of suitable assistants, the elaborate measurements were completed in January 1832, and Olliver's work brought to a close six months later [3, 48–50].

There was a great deal of other work to be done. Plans had to be worked out for completing the Great Arc, and for subordinate triangles [15–23]. Officers and assistants had to be collected and trained for field work. An office staff was necessary for the heavy computations. A workshop had to be established for maintaining the delicate instruments in repair. The new instruments from England had to be assembled and adjusted, and old ones renovated. Establishments and salaries had to be approved by Government.

Whilst the primary task was the extention of the Great Arc to the hills, the Directors had ordered that triangles should be run northwards from Olliver's longitudinal chain so as to fix points that "would enable us to complete the geography of the Bengal provinces in a satisfactory manner" [III, 186]. To effect this Everest proposed to run ten chains of triangles at about one degree interval, picking up important towns as the Directors had suggested[4] [pls. II, 24] :

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[1] M Gen. J. T. Walker (1826–96), Bo. Engrs. ; FRS. ; SG. 1878–84 ; STS. 1861–83. [2] *GTS.*, II (2–3).
[3] suggested by Blacker in 1824 [III, 241]; cf. *Topo GR.* 1864–5 (19); 1881–2 (2–5). [4] CD to B. 26–5–30; 20–7–31.

> I might mention Lucknow; Mr. Olliver's meridian of Khurara [68–70] would, when produced, nearly pass thro' this place, and a small branch might be thrown off so as to include Cawnpore, a point on which the map of the Lower Dooab mainly depends [III, 24]. Supposing any objection to exist to prosecuting operations of this nature in the kingdom of Oude[1], the prolongation of the meridian of Umooah would fall upon the latter place nearly [67–8]. Allahabad, another important point, would be reached by the meridian of Goorwanee; Furrukhabad and Bareilly...by the meridian of Ranghir. With regard to more western points, they must follow the prolongation of the grand meridional arc from Sironj.
>
> To the eastward, Mr. Olliver's series offers...Parusnath, which prolonged in a southern direction would connect Cuttack, and render available the map of part of that province by the late Lieutenant Buxton [III, 18–9], which is amongst the few maps in this office founded on principles analagous to those of the Great Trigonometrical Survey.
>
> This latter might, perhaps, be the most eligible to commence with, and I...submit...the expediency of immediately appointing an officer to connect the survey of Lieutenant Buxton's with Mr. Olliver's branch series [59–61][2].

Accepting his plan in principle, Government asked Everest to put up detailed proposals for a suitable establishment and an estimate of the cost and time required[3]. Everest replied with a lengthy discussion on the areas to be covered—the officers and men to be recruited—the chains of triangles to be observed—the cost of survey in relation to the economic value of the land—and the possibility of crossing low-lying flat lands by means of towers and scaffolds. He explained the advantages of arranging the principal triangles in definite meridional and longitudinal chains, and leaving the intervals to other surveyors.

He estimated that with two parties on the Great Arc and six on the lesser series the Bengal area would, if all went well, be completed in five years. A single series would advance from 120 to 200 miles a year, requiring one pair of towers every 17 or 18 miles in flat country, or about 20 towers for each series [4, 81–3]. If each tower cost not more than 1,500 rupees, the cost of the whole programme might amount to Rs. 8,40,000, or £77,000,

> a sum which, though sufficiently considerable in itself, would be expended in a purpose which the wisest of men have always pronounced to be practically useful and nationally honorable. ... Triangulation alone...would afford only a skeleton of well established points over the surface of the country, ... but with additional means...the head of the party will be able to establish...secondary points within the areas of his principal triangles, by means of which the topographical details may be filled up with a plane table, in the way adverted to in Captain Herbert's able pamphlet [III, 158 n.3]. This...would be attended with an accuracy quite equal to what could be called for, ... and...on the most economical principles [19, 261–2].

He asked particularly whether this detail survey should be included. It would cost a further Rs. 1,60,000, bringing "the actual cost of a survey of the Presidency of Bengal" to Rs. 10,00,000, ten *lakhs*.

He proposed, after measuring the base-line at Calcutta,

> to proceed to Agra with a sufficient establishment...to form two parties. ... I should send a party to Seronj...where I left off, to carry up approximately a series to Agra, in order that on my arrival there I may know where the Great Meridian will fall; and this having been ascertained it is my intention to proceed northerly with one party to the mountains, and to detach the other southerly under some competent person to fix the approximate series. ...
>
> A base of verification will have to be measured...perhaps at Meerut or even nearer the mountains. It will also be necessary twice to take sets of observation for zenith distance, in order to determine the amplitude of the two sections between Seronj and the extreme north point [5–6, 96–101], ... so that...in three years from the...measurement of the Calcutta base ...the Great Meridional Series might be fully completed, and...5 years hence, ... provided that no obstacles are encountered in crossing the Dooab, ... the East India Company might fairly look to the completion of the Great Trigonometrical Survey [18].

Making proposals for recruiting officers and educated assistants, with *lascars* and *khalāsis*, he lamented the policy that had led to the discharge of a large number of experienced followers during his absence [III, 398][4].

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[1] no objection was made to survey through Oudh. [2] DDn. 265 (118), 10-1-31; cf. (261–91), 12-10-31. [3] BMC. 5-8-31 (198); DDn. 263 (294–7). [4] DDn. 265 (261–91), 12-10-31.

Government granted authority to raise two parties for work on the Great Arc, and to employ Boileau [III, 426] to reconnoitre the line from Sironj to Agra [23]. They were rather alarmed by the expense and delay of building towers, but after Everest had rejected their alternative of a longitudinal series east and west through Agra, they agreed to their construction;

> In any case, the meridian of Parasnath must be extended south to Cuttack, and...no time should be lost in...the commencement of that work.
>
> The Governor General does not approve of your plan of filling up the areas of triangles with topographical details [13, 261], being of opinion that a skeleton map with well established points is all that Government should require at the hands of the Surveyor General[1].

Nothing came of Everest's request for deputies to assist in the control of the three survey branches—Geodetical—Geographical—Topographical [301, 327–8].

> The GEODETICAL will comprise all extended triangulation, whether...for the measurement of arcs of the meridian or parallels of latitude, or geographical purposes. Consequently the following duties fall particularly under that division. ...
>
> 1st. The measurement of base-lines — 2nd. The observation of horizontal and vertical angles — 3rd. The determination of azimuths — 4th. The determination of amplitudes — 5th. The determination of transits — 6th. The examination of instruments, the comparison of standards, and other scientific experiments — 7th. The construction of skeleton plans of triangles on a scale of 8 British miles to 1 inch — 8th. The scientific computations made upon the data derived from the field operations.
>
> The GEOGRAPHICAL will comprise all surveys...in parts of the country little known, which may not be under the immediate orders of the Quarter Master General ; all operations for detail...within the areas of principal triangles ; ... all surveys of rivers and lines of coast not immediately under the Marine Department ; and the construction, compilation, and copying of Geographical maps.
>
> The TOPOGRAPHICAL will consist of all works carried on with a plane table, or small theodolite and chain, made with a view to delineate the more minute features of country, such as positions and sizes of villages, of lakes, natural or artificial, of the areas of cultivated lands, the boundaries of villages, zillahs, etc. Statistical details also fall within this division. ...
>
> Maps constructed in the Geographical Department will, unless directed to the contrary, be on a scale of 4 miles to an inch ; that being the scale selected by the Court of Directors. ...
>
> The Geographical Department will receive, whenever practicable, its data from the Geodetical. They will consist of the distances from each other on the earth's surface between the different places in the skeleton plan ; the heights of principal stations above the level of the sea ; the latitude and longitude of places ; the azimuths, observed or deduced, at the principal stations, and any other particulars which the Geodetical Department can furnish.
>
> The Topographical will draw its data whenever practicable from the Geographical ; but if no Geographical Survey has been before carried on in the tract...reference must be had to the Geodetical. Topographical maps should be on a scale of 2 inches to a mile.
>
> It will appear...that the Geodetical Department is...the basis of every other process of survey, and that its object is to erect so many fixed points, beyond which errors cannot accumulate — that the Geographical is...to delineate correctly the general features of a country — that the object of the Topographical is to describe those features particularly[2].

As the outcome of these discussions six parties were raised and employed on the Great Arc and on the meridional series of South Parasnāth, Budhon, Ranghir and Amua, which were all completed before Everest left India [58–68]. Three others, Karara, Gora, and Chendwar, with the longitudinal connecting series, were started during Everest's last three years [pls. 11, 23].

In April 1831, Shortrede and his triangulation in the Bombay Presidency [72–5] were placed under the Surveyor General's control[3], and he decided, after close enquiry into methods and results, that the work was not fit for incorporation with the Great Trigonometrical Survey. After much acrimonious correspondence, Shortrede was relieved by William Jacob who started afresh and, adhering strictly to Everest's rigid instructions, re-observed and extended the series of 1822–3 [III, 234–6] as the Bombay Longitudinal Series.

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[1] DDn. 282 (32–7), 27–2–32. [2] DDn. 283 (54–61), 27–3–32. [3] SG. to Mil. Dept. 10–1–31 ; BMC. 2–4–31 ; CD to Bo. 1–3–31 ; and CD to B. 26–5–30.

In December 1832, having established a computing office under De Penning, and a workshop under Barrow, Everest sent his field office up country to Mussoorie, and himself went to Agra, via Saugor and Gwalior, to meet his reconnaissance parties and see the ground for himself.

> It was not until the end of 1832 that I was in a condition to leave Calcutta for...resuming the operations of the Great Arc Series. ...
>
> Though I had no persons...at this period whom I deemed strictly speaking efficient, yet there were some few members remaining of the old establishment who had a highly useful practical acquaintance with...trigonometrical operations, and as I had to train an entirely new set of young men, I determined to send them into the field under the guidance of Mr. Rossenrode, one of the most skilful of my former subordinates, whom I deputed to carry on an approximate series along the meridian of the Great Arc, whereby the sites of principal stations might be selected beforehand, as far at least as the Chambal River [24–5]. ...
>
> I also took measures to have the tract of country to the north of the Chambal explored by Mr. Olliver...and by Captain Boileau, ... so that I might obtain a general idea of the direction of the meridian, and the points at which it would be most convenient to fix the northern limit of the section, and to measure a base of verification[1].

He spent the rains of 1833 in Mussoorie and, after finding suitable ground near Dehra Dūn for a base-line [50–1], spent the working season 1833–4 laying out stations for the Great Arc northwards across the Jumna-Ganges *doāb* [26–38].

> By the beginning of May [1834] the stations to the north of the Chambal, 35 in number, were all selected, and this laborious work brought to a satisfactory conclusion by approximately connecting the proposed site of the base of verification in the Dūn with that measured by me ...in the plains of Seronj in 1824. ...
>
> It was unquestionably the most harassing duty I ever had to perform, and I had to bear nearly the whole burden of the arduous task myself, for there was at that time no person at my disposal to whom I could depute any portion of the work, except under my own immediate supervision and control. Day and night at all hours from the 13th December, when my observations commenced at Dimdima, till 4th May, when they terminated at Amsot, I was perpetually in a state of excitement and anxiety [4–5, 37–8].
>
> It now remained to give instructions and drawings to the executive officers of the building department, to enable them to proceed with the construction of the towers[2].

The fourteen towers of the Great Arc cost just under Rs. 30,000 and, writes Burrard in 1935, their building was a bold conception,

> and cost a lot of money. But the money has been proved to have been well spent, for we could not have done without these magnificent towers. I observed at the Nojli tower near Rurki 60 years after it had been built. Nojli tower...has proved invaluable for observing the Himalaya snows, Nanda Devi, Badrinath, etc., but it was not erected for this purpose, but for triangulating the plains. I may be exaggerating, but his towers always seem to me to be an amazing monument to Everest's enterprize and conception[3] [pl. 5].

The Dehra Dūn base-line was measured during field season 1834–5 [51–3], and observations on the Great Arc between Dehra and Sironj were completed during seasons 1835–6 and 1836–7. Whilst the southern section still remained, Everest expressed apprehension about its successful closing ;

> It is impossible to say...how an extended series...of this kind will eventually turn out. ... It may so happen that diverse parts even of the horizontal triangulation may have to be revised. ... The general distance of separation between two bases has seldom much exceeded 200 miles, but between those of Sironj and Dehra there is a line of 433 miles. ...
>
> It is my intention to proceed early in October to Seronj, taking...Lieutenants Waugh and Jones to form two parties, each with one of the 3-feet theodolites and, starting from my old points of Kalianpur and Bhairasa [III, pl. 17 ; IV, pl. 4], to triangulate northwards to the Chambul. ... When the horizontal angles are all finished a precise idea may be formed of the value of the immediate work. If on closing in there should appear to be no error more than usual, ... an intermediate base will certainly not have to be measured. ...
>
> The horizontal angles, which are by far the most important and delicate part, ... being satisfactorily concluded, I purpose to proceed without loss of time to rectify...the determination of height by means of vertical angles simultaneously observed [41][4].

Meridional Arc (xii). [2] ib. (xxiii). [3] photo Nojhli Tower, Burrard & Hayden (53) ; Sandes, II 216) ; letter of 6–5–1935. [4] Report, 30–8–36 (68–74).

His apprehensions were justified ;

> It was with some concern...that I found...that the computed value brought down to Sironj from the Dehra Dun base exceeded that measured by the old chain by nearly 3½ feet, a quantity which, though small in respect to the length of the base, ... is yet large...in matters connected with the figure of the earth.
>
> It did not follow, however, that this error had been generated in the triangulation ; it might have been caused by the irregularity of the chain...which I have always looked on as a very treacherous implement [III, 250-1]. ... If the old implement used in measuring the Sironj base in 1824 were really faulty, it was in vain to use that measurement...to determine the accuracy of work performed with instruments which it could not compete with [5, 17]. ... As the only method of setting this point at rest, I resolved on remeasuring the Sironj base...with the same compensation bars which been had used in the year 1834-5 in the Dehra Dun[1].

In reporting this discrepancy to Government he pointed out that

> this disagreement is hardly a matter of surprise, and will, there is little doubt, disappear in part or entirely when tested by the more improved apparatus[2]. Until two bases are finally connected with each other by an intermediate series of triangles, no person can pronounce... with safety as to the coincidence of the computed and measured lines. ...
>
> As far as the triangulation had been carried to the south of Dehra Dūn base, it had been effected in a style far, very far, superior to anything I had ever witnessed or read of, and I knew that the remainder of the work would be executed quite in keeping with, if not surpassing, it. Lastly I knew that, come what might, there was no error in the Dehra Dūn base, for there no latent source was to be dreaded[3].

The remeasurement was approved, and at the end of the rains Waugh took the apparatus down to Sironj in time for the base to be measured by the end of January 1838 [41, 53-4]. The discrepancy disappeared, and Everest reported on 5th May that he had brought "the terrestial work...between Seronj and the Himalayan mountains to a conclusion"[4].

There still remained the observation of zenith distances which, after the reconstruction of the defective circles, was effected during 1839-40 and 1840-1 as described elsewhere [5-6, 96-101]. In the meantime Everest obtained sanction for the re-observation of the triangles between Sironj and Bīdar ;

> The triangulation was executed with very inferior instruments, ... for the portion between Beder and Pilkher was performed with an 18-inch instrument...of no great accuracy[5], whilst in the remaining portion between Pilkher and Seronj the old large theodolite...was employed [III, 239]. ... The...observations...exhibit discordancies *inter se* seldom less than 20″, and in one case to so large an amount as 36″·5. ... The errors in the triangles...frequently amount to 4″ and 5″, and in one case there is an error...exceeding 11″. ...
>
> There is a discrepancy between the base measured at Beder and that brought down from computation in terms of the Takal Khera base of upwards of 6⅔ feet, whilst the comparison between the bases of Takal Khera and Seronj...shows little more than 3 inches. There is an uncertainty about the azimuths in the whole extent between Beder and Seronj. ...
>
> The time seemed now propitious to rectify these matters, and as this was the favourable season for crossing the Mahadeo mountains without danger, I determined on detaching Captain Waugh to the southward, that he might be in readiness to take advantage of the opening of the season of 1838-9...to begin the revision of the angles in the neighbourhood of Beder with Troughton's large theodolite, and proceed northwards, whilst I with my large theodolite proceeded southward till we met each other [41-2].
>
> It was, however, by no means certain that the whole discrepancy between the two bases... was attributable to the triangulation, for what had been detected in the case of the Seronj base might...have happened in that of Beder, so that the question could never be satisfactorily set at rest until that base was also remeasured[6].
>
> The sites of the old stations will not require to be changed, wherefore the work...may be expected to proceed with great rapidity, more especially now that by the introduction of lamps and heliotropes the healthy season between October and June has been substituted for the baneful period between June and January [III, 246-7]. ... If Lieutenant Waugh can...begin his triangulation at Beder in October next, he will certainly extend it up to Ellichpur ... by the end of February...and thereby set that part of the doubt entirely at rest. ...

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[1] Report, 3-8-39 (76-80). [2] DDn. 342 (14-8), 18-5-37. [3] ib. (66-7), 28-12-37. [4] ib. (148) 5-5-38. [5] sold to Nāgpur Svy. 1823 [143]. [6] *Meridional Arc* (xxxv-vi).

> Though the agreement between the old bases of Takalkhera and Seronj would seem to render that section free from impugnment, yet there are certain circumstances...which render it highly desirable that that triangulation should also be revised. ... I will make it my business next cold season to do all that is requisite...so that by March or April of 1839, if no accidents ...should be encountered, I promise to myself the satisfaction...of reporting the whole terrestial arc between Beder and Dehra Dūn entirely finished, all but the Beder base[1].

Government accepted these proposals, "relying with confidence on the soundness of your judgement" and "unwilling to check the completion of an undertaking in which such large sums have already been expended[2]. The re-observation was carried outduring season 1838–9, with Renny taking the northern section in place of Everest [41–2].

Everest was equally anxious to remeasure the base-line at Bīdar;

> The general principle in every extended series of triangles is that one base-line should be measured at the point where such series originates, and another at the point where it ends. ... Each of these bases being connected with the principal triangles...either of them becomes verificatory of the other, but...both must be measured with equal regard to accuracy, for to take that which is defective as a test of that which is perfect is manifestly...illogical. An agreement between the computed and measured bases...proves nothing whatever, for such coincidences are the merest matters of accident, and...often...occur where the connecting triangulation has been replete with faults [III, 201 ; IV, t-page, 101].
>
> Now, there is satisfactory proof that the implement with which the old base-line at Beder was measured by Lt Col. Lambton was highly faulty, and...the base at Sironj in which the same implement was employed has been thrown aside and replaced by a new measurement. ... These are the grounds on which...a base in the valley of the Manjira near Beder must be remeasured with compensation bars. ... Sooner or later this measurement must be made[3] [5, 55].

After approval by the Directors, a new base near Bīdar was measured by Waugh at the latter end of 1841, no trace being found of Lambton's old line. On the other hand permission to re-observe all Lambton's work right down to Cape Comorin was firmly refused, and Government,

> seeing nothing...to shake the confidence reposed hitherto...in the results deduced by Colonel Lambton, ... wishes that, when the Bedur base has been remeasured, the meridional series shall be considered as completed for the geodesical objects in view, and that the triangulations to be prosecuted thenceforward shall be confined purely to Geographical objects[4].

Everest lamented this decision, the more so because considerable discrepancies were found when Waugh connected up to the old stations south of Bīdar;

> In general the old central marks appear to have been obliterated or removed. ... The discrepancies...are not only large but irregular [43, 55].
>
> The portion of the Great Arc series which was executed by Lieutenant Colonel Lambton in person appears to be comprised between the station of Perrioomalli in the parallel of 9° 13′ and Pagur in latitude 14° 6′ [II, pls. 16, 17]. ... The portion south of Perrioomalli as far as Cape Comorin was executed by Mr. De Penning [II, 243 n.2]; the portion north of Paghur as far as Koelacondah in the latitude 15° 20′ was performed by Lieutenant Riddell assisted by Mr. Sub-Assistant Lawrence, and the portion between Koilacondah and the Beder base by diverse individuals, whose names are not recorded in the angle books[5]. ...
>
> The portion...which Lt Colonel Lambton himself performed appears to have been executed with the large theodolite between March 1804 and August 1809, and as this instrument was originally an exquisite piece of workmanship, and did not receive its injury until 1808 [II, 241–2], it is probable that all of this portion...is perfect. ... It by no means follows that the same concession is to be made to everybody who happened to act under his orders [III, 252]. ...
>
> However, it is too late to think of remedying this now ; the...occasion is lost, and, hereafter, ... it will be attended with a cost of time and money far greater than that for which it might have been accomplished whilst the parties were on the spot, all trained, efficient, and zealous to undertake it, and provided with instruments the first in the world [II, 267][6].

Everest now spent 1842 and 1843 on the computations and charts of his two sections, Bīdar to Sironj, and Sironj to Dehra Dūn. His official manuscript reports were signed before he left, and his final printed report was published in London in 1847 [110–2, 113].

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[1] DDn. 342 (100–11), 26–1–38.

[2] from Mil. Dept., DDn. 341 (202–4), 13–2–38.

[3] Report, 3–8–39 (177–81, 185); B to CD., 3–10–39 (6–7).

[4] DDn. 343 (338–55), 7–10–40.

[5] Lambton himself obsd. up to Bidar [II, 249]; pencil notes of the observers entered on 8-mile chart, probably by De Penning for the purpose of this report [II, 264].

[6] Report, 1842 (153–6).

SUBORDINATE MERIDIONAL SERIES

As the operations of the Great Arc drew to a close, Everest asked for orders regarding the subordinate meridional series, of which four only had so far been taken up, Budhon, Ranghir, Amua, and Karara. He asked that the parties freed from the Great Arc should take up the two next series to the east, and that work should be started on a longitudinal series along the foothills to the north, on which the several meridional series should close.

He called attention to the large closing errors of the Calcutta Longitudinal Series [iii, 264 ; iv, 58], and recommended that each of the meridional series

> ought either to be terminated by a base-line of its own, or to be connected at the northern limit with a chain of triangles emanating from the Great Arc Series, and running eastward. ...
>
> The latter is by far the more simple, expeditious, and useful process of the two. ... A series of triangles...running through mountain lands, ... besides forming a connection of all the heads of the series...and thereby binding the whole into one uniform map, itself furnishes highly valuable geographical data[1].

This request was passed to the Directors, who gave no definite orders beyond pressing for speedy completion of the triangulation "in order that the geography of the territories between the meridional arc and Calcutta, north of the longitudinal series, may be laid down and completed". They did not think that such errors as had been found in the Calcutta Longitudinal Series would affect "a geographical map on a scale of 4 miles to an inch"[2].

This led to a long correspondence between the Government of India and the Surveyor General, in which Everest was blamed for having dropped so far behind his optimistic estimates of 1831 [13], whilst he retorted with long accounts of delays, already reported, which had been quite beyond his control.

Government questioned the need for such high precision for these 'minor series', and asked whether, in preference to infringing the boundaries of Nepāl, "the object... would not be more effectually answered by running a longitudinal series from Agra or Delhi to the extreme eastern frontier, ... and connecting it with a meridian carried north from Calcutta"[3]. Everest protested against the term 'minor series',

> which latter appellation is given to series of secondary triangles...in which on account of their smallness the spherical excess is not computed. The series in question are called in the department 'subordinate meridional series', but they are, nevertheless, geodetical operations under which general head are alike included all triangles treated as spherical[4].

He emphatically rejected the idea of a long series running east from Agra "through a dead flat almost the whole way", in which the sides would have to be restricted to 8 or 10 miles, and which would in no way serve the purpose of a series along the foothills to the north [20]. Government surrendered at last and authorized a longitudinal series from the head of the Great Arc to connect up the Budhon, Ranghir, and Amua series, but without infringing Nepāl territory[5] [71].

On two points in this correspondence Everest expressed himself very strongly—the suggestion that the standard of accuracy for the meridional series might well be lowered—and a desire that he should employ the parties from the Great Arc on filling up the intervals between the meridional series with minor triangulation. At the same time he challenged the authority recently given to the Survey Committee in Calcutta to turn out maps without regard to trigonometrical control [iv, 11, 300–1], and thus restated the general principles of the Great Trigonometrical Survey ;

> A complete and accurate topographical survey of the whole of India...is perhaps of itself the most herculean undertaking on which any Government ever embarked. ...
>
> [The first essential is] a series of principal triangles originating from, and terminated by, a well determined line. Minor triangles depending on the sides, and covering the areas, of the principal triangles, thereby fixing limits to inaccuracy at distances of two to three miles asunder, and topographical details depending on...the triangles, carried on either with the planetable, or with the theodolite and chain. ... All else is but patchwork...which will never satisfy expectation or promote the national respectability. ...

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[1] Report, 21–8–39 (68–9). [2] CD to B., 10–6–40 (20–2). [3] DDn. 343 (364–8), 30–12–40. [4] DDn. 402 (133–49), 1–4–41. [5] B to CD., 30–5–40 (29/3) ; DMC. 14–4–41.

> That which is used for a basis of other operations ought to be itself as free from error as instrumental means and human care can make it. There is no putting limits to error within this, because there is no knowing where it lies, or how it has been generated. ... As one of the greatest evils...is the liability to make mistakes, from which no human being can hope to be exempt, the most efficient means should be provided for the supervision [t-page, 108].
>
> The basis of all accurate topography is the figure and dimensions of the earth ; without an accurate knowledge of these, distances measured on the earth's surface in feet and miles are not susceptible of reduction to latitude and longitude. ... It is, I know, the fashion to say that the figure and dimensions of the earth form only a metaphysical question for philosophers... to divert themselves with, but that is a mistake, originating pure ignorance [III, 241][1].

Government was still unconvinced, and pressed for geographical results without waiting for the satisfactory closing that Everest had recommended. They saw no need to worry because the longitudinal series closed with an error of about

> 13 inches per mile [50]—because the latitudes, longitudes, and azimuths have been computed only by two parties and not by four—and lastly because the computations have been made by one person only...instead of being independently worked by two computers. ...
>
> The Governor General in Council is quite satisfied with the degree of accuracy obtained under these disadvantages and omissions, and would on no account desire that the results of the expensive operations on which you are employed should be withheld from the world until the opportunity shall be found of applying these extreme tests. ...
>
> The utmost...that can be attained by human skill and care is only an approximation to perfect accuracy, and there is a degree beyond which the expense...far exceeds...the value of the end. ... This principal may...be applied with fitness to geographical surveys, which it cannot be necessary to carry beyond that degree of accuracy which is susceptible of expression on maps of the largest scale ordinarily constructed. ...
>
> Upon the completion of each series of triangulation it is important to make public its results by publishing, with a plan, a list of the places whose latitudes and longitudes have been ascertained[2].

Everest replied that he was brought up to obey orders, and would do so if desired, even to the extent of the longitudinal series from Agra, but when

> the series of the Great Arc, Budhon, Ranghir, Amua, Karara, etc., are all completed, there will be no necessity for a longitudinal series of the nature proposed. ... The positions of all places lying intermediate to any two of them could be, without any apprehension of error, fixed by secondary triangles. ...
>
> For geographical purposes it is not the amount of individual error which need be dreaded, but the accumulation of errors, which may, without proper care, cause a serious discrepancy. ... There is no plan so good as that already in progress of carrying up meridional series of principal triangles, and filling up the spaces between them with secondary triangles. ...
>
> The geography of India and the best means of completing the Honourable Company's Atlas was discussed with great ability, and at some length, by Major Rennell and Colonel Blacker in 1823-4 [III, 185, 240-1], and there is a very able minute by Lord Wm. Bentinck subsequent to these [III, 195-6], which seems to bring the discussion to a satisfactory close. His Lordship's opinions seem to me quite unanswerable, and as the system now in operation is precisely in accordance therewith—with the practice of Colonel Lambton—and the expressed wishes of the Honourable Court of Directors—I really do not see...how I can...devise any scheme founded on different principles [262]. ...
>
> I have no intention of remaining in India...to superintend the working of any new plan[3].

Reference was made to the Directors who replied that on the close of the Great Arc

> the establishment...should be divided into separate parties, and employed...on meridians to the east of those already completed, or in progress, ... according to the plan already proposed.
>
> We do not consider it necessary...that any systematic plan should be adopted for triangulating the country between [13-4]. ... Topographical surveys have already been carried over a large portion of the tracts through which these meridians pass. ...
>
> Should further data be required to connect the topographical surveys, or...to fill up spaces between these meridians, ... the work may be correctly and expeditiously performed by surveyed lines of route similar to those executed by Captain Gerard from Agra to Bhopal [III, 89, 202], ... the surveyor being directed to make a station of a meridional series the starting point, as well as another station of the next series the termination, of such series[4].

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[1] DDn. 402 (115-22), 11-9-40. [2] BMC. 10-2-41, DDn. 401 (4-7). [3] DDn. 402 (133-49), 1-4-41.
[4] CD to B. 1-2-41 ; DDn. 401 (89-92).

Everest very much doubted the mapping value of the old surveys, even when connected up by the new triangulation, though

> much of the work executed by...the Revenue Surveys will...be susceptible of...combination, and it is certainly to be desired that work of that quality should be made available [233]. There may, perhaps, on the other hand, be materials which will not serve the purposes of the atlas sheets unless more or less violence be resorted to, to fit them into each other in their proper places. ... All materials which are not radically bad may be turned into account [229, 320].

He asked for clear orders ;

> 1st. Whether it is the intention of His Lordship that meridional series further east than the Karara station...shall be prosecuted.
>
> 2nd. Whether...those series shall be continued with the same regard to accuracy which has hitherto been observed, or whether an inferior degree of accuracy will suffice.
>
> 3rd. I have been brought up in the school of accuracy, ... but should it be the opinion of my superiors that these principles ought to be more or less departed from, I am quite prepared to do my best. ...
>
> 4th. I judge...that it will accord with the views of His Lordship in Council to employ 12-inch theodolites in principal triangles, to abandon the use of heliotropes, lamps, and night observations entirely. ... This will be a great saving of expense and time, but at a sacrifice of accuracy, and the only question...becomes now for the decision of the Honourable Court. ...
>
> 5th. The chief occasion for extreme attention to accuracy...disappears with the completion of the Great Arc series, and the object seems to me now to retain just so much regard to minutiae as will suffice to protect our future work from the liability to...be done over again for topographical purposes, and at the same time to limit the expence as much as possible[1].

He suggested referring these points to a departmental committee, but Government wished the plan of work to be put up by the Head of the Department,

> complete in all its details, after consulting your several assistants and subordinates. ... The points upon which the Government will expect specific rules from you...are ;
>
> First, The number, constitution, and strength of the parties to be formed for conducting meridional series. ... Secondly, ... The longitudes in which the several parties shall respectively commence the new lines. ... Thirdly, The manner in which you propose to test the accuracy of the work of each series upon its reaching the northernmost limits. ... Fourthly, If the system of meridional series at given distances is to be that adopted for Bengal, Behar, and Hindoostan, the Government will expect you to explain why the same plan should not be followed out to the southward—in the Nizam's territories—and...the Madras territory[2].

Everest made cautious reply. He proposed no change in the number of field parties, but suggested that the number of assistants in each should be increased from two to three. As regards the interval between each series, he repeated the recommendations he had made in 1831, specifying the series to be, from west to east—Budhon, Ranghir, Amua, Karara, Gurwāni, Gora, Hurilong, Chendwar, Parasnāth, and Maluncha—ten series in all, approximately one degree apart. As no operations were permitted beyond the Nepāl boundary, he abandoned the plan for a longitudinal series along the foothills;

> It will be easy when each of the meridional series...attains its northernmost limit...to carry a simple series to the west or east till it meets the...series contiguous to it, and spare...the necessity of measuring a base of verification at the termination of each series [67–8, 71].

He stated that he had not had time since the abolition of the Deputy Surveyor General at Madras to consider the system of control of the Hyderābād or Madras surveys, but that, if given permission to correspond with the authorities at Madras, he would look into the matter [249].

> With reference to further operations, I beg...that the following be laid down as settled general principles. 1st, That all trigonometrical series...be concentrated as much as possible. ... 4th, That the...immediate object under the Bengal Presidency is that of conducting the meridional series...over the valley of the Jumna and Ganges. 5th, That, until this work is completed, no other trigonometrical operations be undertaken. ... 7th, That the Superintendent be not expected to take a working part in the observations of meridional series, but that his duty be to superintend...the labours of his subordinates, and preserve uniformity and efficiency throughout the operations[3].

Government approved this programme, allowing six field parties ;

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[1] DDn. 402 (197-207), 13-12-41. [2] BMC. 26-1-42 ; DDn. 401 (116-21). [3] DDn. 402 (256-67), 1-3-42.

Each of these six parties will therefore cost per mensem 2,129 rupees. Principal Assistant, Rs. 883—Three Sub-Assistants, @ Rs. 313, 260 and 173, Rs. 746—Establishment and contingencies, Rs. 500.

The scheme embraces the continuance in the field of yourself, or some other superintendent, ... so that during the working season you may take tours of inspection, ... taking no part, however, in the executive operations. ... The headquarters of the Superintendent shall be at present at Agra, but when the two westernmost series are completed, they should be removed to Benares, and eventually to Buxar and Monghyr. ...

The Superintendent continuing in the field while holding also the situation of Surveyor General seems...of doubtful expediency, and the President in Council would prefer that you ...resume the personal direction of the office of Surveyor General at the Presidency. ...

Undoubtedly, next to reticulating the continent of India with triangulation covering the entire space, the method of consecutive series connected at the extremities in the gridiron form appears to afford the best possible...groundwork for...a general map, but...I am...to ask within what period...the ten consecutive meridional series...will be completed. ... Even when completed, there will still remain all the country west of Delhie and east of Calcutta...besides the unsurveyed tracts to the south of the Seronj longitudinal line[1].

Everest described the present state of the several series ;

If my office be immediately removed to the Presidency, the effect will be retard rather than to expedite the completion, and though I have great confidence in the ability, talents, zeal, and judgement of Lieutenants Waugh and Renny, and my sub-assistants generally, ... the presence...of the principal, who has been the instructor of all, is far from nugatory ...

The series of Budhon, Ranghir, Amua, will be completed and connected with each other on the north side by June 1843. The series of Gurwani and Gora will in like manner be completed and connected with each other by June 1846. The other series to the east of Gora will each be similarly completed and connected with each other in four years from the time of its being taken in hand, which ought to be by June 1847.

This estimate will serve as a guide for...plain countries which present by far the greatest difficulties. ... In hilly regions a much more rapid progress may be calculated on. ...

I really see no benefit...by going helter-skelter about any work whatever, intended to be final. Trigonometrical operations have been found to be costly, and to need system, method, patience, care, and time. ... The general object in a long and extensive work of this nature is to complete each distinct portion effectually before the others are taken in hand. ...

The Hon'ble Court of Directors...have called so repeatedly for the complete triangulation of the Doab and Rohilcund, that it has been...the deepest mortification to me to... acknowledge my inability to give immediate compliance with their wishes[2].

Whilst accepting this programme, Government regretted the expense ;

If the Trigonometrical Survey of India be prosecuted consecutively, ... at least an equal sum must be allowed for the districts east of Calcutta, and half a crore[3] will be a low estimate for...triangulation on the same gridiron principle of the whole continent of India.

As the cost is a matter of importance, and as the number of meridians and their distance from one another is an essential element of the charge, the President in Council conceives that the object desired may be accomplished very nearly as effectually, ... and far more expeditiously, by augmenting the distance so as to diminish by one half the number of meridians between Calcutta and Seronj.

It is therefore desirable...that a distance of two instead of one degree of longitude should be allowed between the lines of triangulation.

Under this restriction Gurwāni and Hurilong series were to be omitted[4]. Everest's strong protest was referred to the Directors, who countermanded these orders in a letter which reached India just before he left ;

We unite with you in an anxious desire to carry on and finish at the least possible expense the trigonometrical operations which still remain to be completed. But our objects will not be effectually attained unless the work has a character of perfection and finality, which will render altogether unnecessary any future surveys. ...

We now learn that...you have resolved that the meridians between Karara and Calcutta shall be diminished by one half, the distances between them averaging upwards of 100 miles. We apprehend that this...will prevent that degree of accuracy which we are desirous to attain...and will thus materially affect the permanent character of the work.

---

[1] DDn. 401 (154-64). 15-6-42. [2] DDn. 402 (371-86), 15-8-42. [3] one *crore* = Rs. 10,000,000.
[4] DDn. 401 (223-8), 25-11-42.

The objection...to...proceeding first with the meridians of Gora and Hazareebagh [or Chendwar]...is that the distances between Karara and Gora, and between Gora and Hazareebagh, being respectively about 120 to 140 miles, we anticipate a necessity hereafter for measuring intermediate meridians, ... and meanwhile the progress of the Atlas of India in that direction will be suspended[1].

In July 1842 Everest reported the completion of Budhon and Ranghir series, as also the two connecting series linking them together on the north ; the Amua series had been completed some time before. When he left at the end of 1843, parties had taken the field for the six series — North Longitudinal — Karara — Gora — Chendwar — Maluncha — Calcutta [58–9].

The principal triangulation of Rohilcand is completed according to the principles originally developed by me in 1831, and that of the Doab only needs the completion of the Karara series and its connection with that of Amua. ...

In as far as linear distances are connected, ... the work...is [not only] in point of accuracy amply sufficient for the purposes of the Hon'ble Company's Atlas, but...will hold no mean rank in comparison with geodetical operations in other parts of the Globe.

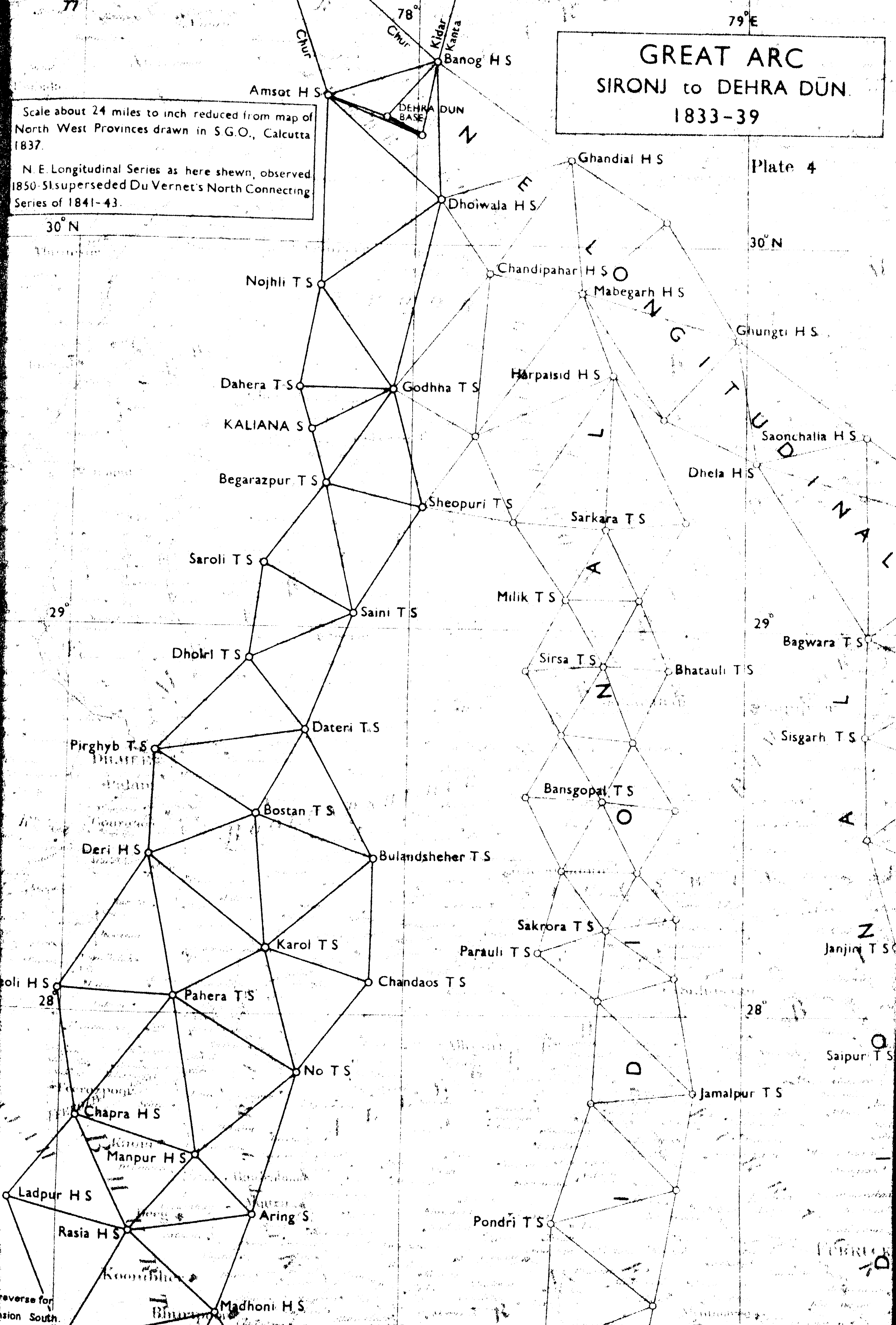
It is not to be looked for that these subordinate series shall compete with our Great Arc operations, and I do not know how far my esteemed friend, the Superintendent of the G.T. Survey of Ireland [000], will admit them to equal pretensions with his own magnificent labours, but, as to all published operations, whether in Europe, Africa, or America, with which I am acquainted, ... the present...may at least claim equality[2].

Everest had now completed the task for which he came out in 1830, and he left the Great Trigonometrical Survey proceeding smoothly on a programme that would complete to the full the dream of his great master, William Lambton.

That the whole of India will be eventually covered with triangles may be looked for as a result almost as certain as any future event can be [t-page], for it was only after long deliberation that the Court of Directors...came to the resolution of making their Atlas depend on trigonometrical operations. ...

Here closes my long and laborious undertaking in which, though from first to last I have necessarily gone through much hardship and privation, yet these have not been without many alternations of gratification and amusement[3] [t-page].

[1] CD to B., Mil., 26–9–43 (30–2). [2] DDn. 452 (30–6) 10–7–43 ; on review made 1938, these meridional series were classed as secondary work only : *PP*. 28. [3] *Meridional Arc* (7–8) ; cf. Lambton's joy in having accomplished a worth-while task [III : 466].



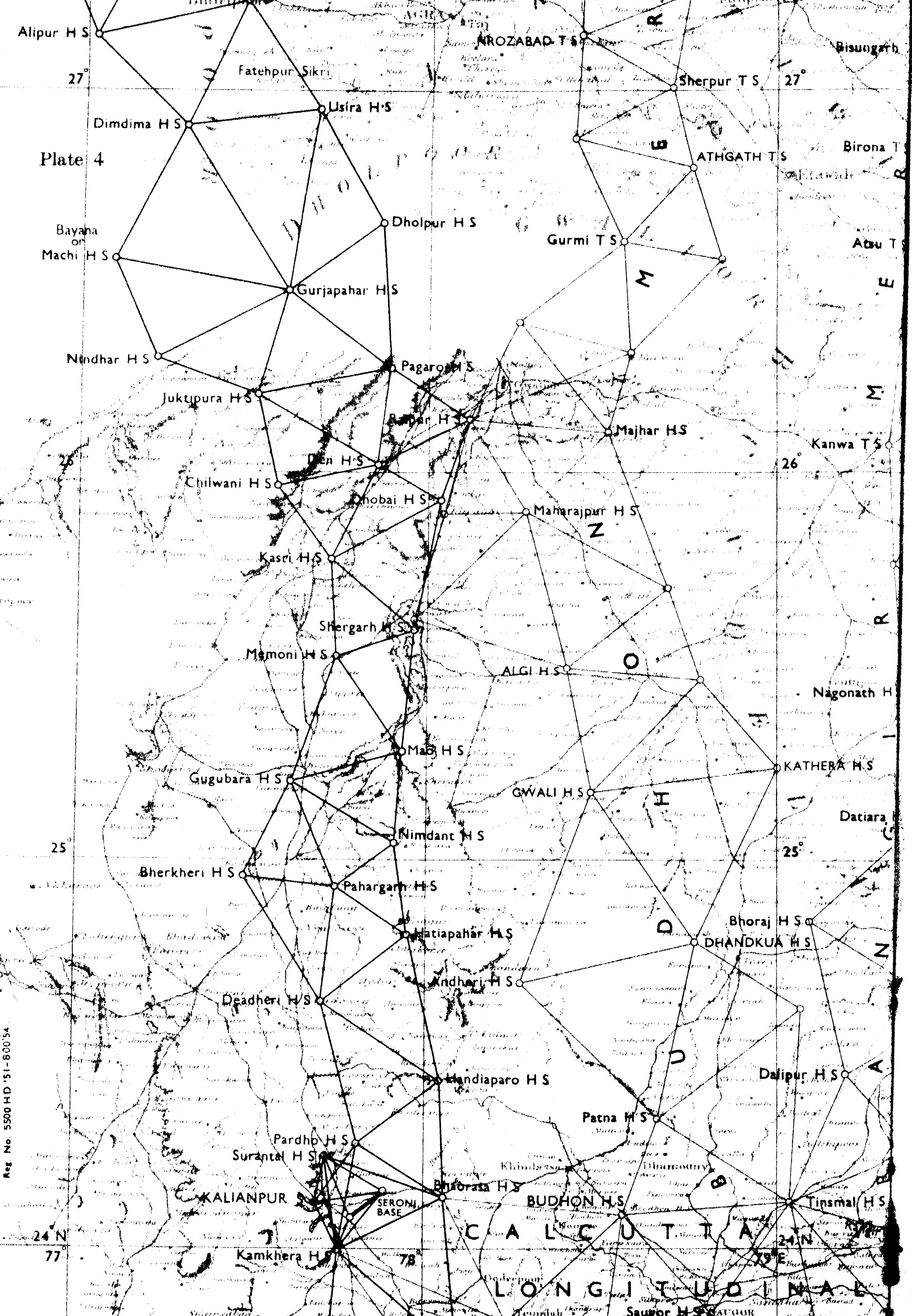
GREAT ARC
SIRONJ to DEHRA DŪN
1833-39

Plate 4

Scale about 24 miles to inch reduced from map of North West Provinces drawn in S.G.O., Calcutta 1837.

N. E. Longitudinal Series as here shewn, observed 1850-51, superseded Du Vernet's North Connecting Series of 1841-43.

Plate 4


Alipur H S
AGRA
FIROZABAD T S
Bisungarh
27°
Fatehpur Sikri
Sherpur T S
27°
Usira H S
Dimdima H S
Birona T
ATHGATH T S
Dholpur H S
Bayana or Machi H S
Gurmi T S
Atsu T
Gurjapahar H S
Nindhar H S
Pagaro H S
Juktipura H S
Rajpur H S
Majhar H S
Kanwa T S
26°
Dien H S
26°
Chilwani H S
Dhobai H S
Maharajpur H S
Kasri H S
Shergarh H S
Memoni H S
ALGI H S
Nagonath H
Mao H S
KATHERA H S
Gugubara H S
GWALI H S
Datiara
Nimdant H S
25°
25°
Bherkheri H S
Pahargarh H S
Bhoraj H S
Hatiapahar H S
DHANDKUA H S
Andheri H S
Deadheri H S
Dalipur H S
Handiaparo H S
Patna H S
Pardho H S
Surantal H S
Bhaorasa H S
KALIANPUR
SERONJ BASE
BUDHON H S
Tinsmal H S
24°N
24°N
77°
Kamkhera H S
78°
79°E
Saugor H S
CALCUTTA
LONGITUDINAL
MERIDIONAL
DHOLPUR
GWALIOR
BUNDELKHAND
SERIES
Reg. No. 5500 HD '51-800'54

CHAPTER III

THE GREAT ARC

RECONNAISSANCE ; *Sironj to Agra, 1831–3* — *Agra to Dehra, 1833–4* — **OBSERVATIONS** ; *Dehra to Sironj, 1834–7* — *Revision, Sironj to Bīdar, 1838–9* — **CONCLUSION.**

THE great task that filled Everest's heart on his return to India was the extension of Lambton's great arc of triangles to the Himālaya.

For two years he was kept exceedingly busy in Calcutta collecting and training a new staff, assembling his instruments, and measuring an important base-line [3, 48–50]. But his thoughts were constantly turned to that Upper India which he had never seen, and about whose geography he knew so little, except that there was a wide flat stretch that would be a most formidable obstacle to his triangles.

To make a start he deputed Boileau from Bharatpur [III, 243–5 ; IV, 2, 14] to carry northward to Agra[1] "an approximate series of triangles from my points near Sironj". Boileau started work at Sironj at the end of April 1832, and fixed several hill-tops for about 40 miles to the north with a small theodolite and an "azimuth compass" [I : 200–1][2], but closed work on 19th June when,

> finding that the weather was so thick that there was no probability of my being able to carry on a series, even of approximate triangulation, within any assignable period, the survey was discontinued, ... and after remaining 3 or 4 days at Bhorasa [III, pl. 17 ; IV, pl. 4], I packed up and am now making the best of my way to Agra, ... a distance of 180 miles[3].

His work of the past four years had given him little experience of the type of work now required, and Everest reported with disgust that he "marched down to Sironj and returned to Agra, giving up the task in despair, ... the most utter failure which had ever been known in the Great Trigonometrical Survey of India"[4] [354].

After the rains, Everest directed him to reconnoitre northwards from Agra ;

> A party under my Principal Sub-Assistant Mr. Rossenrode will be employed this cold season in bringing up an approximate series from Sironj to the Jumna. Until this series reaches the Doab, it is impossible to say precisely where the meridian will fall, but if any sort of dependence may be placed in the maps in my office[5] it will pass close to Futtihpoor Sikri which, being the last of the hills south of the Jumna, and conveniently situated, ... cannot but form one of the principal stations. ...
>
> In order that the series may be prosecuted through the Dooab [pl. 1], it will be necessary to erect artificial eminences wherever the principal stations cannot be established on natural elevations, but the towers built for that purpose are very costly, and it is one of the fundamental principles of the Great Trigonometrical Survey never to expend the public money unless in cases of paramount necessity.
>
> The triangles ought to be symmetrical—...no angle should exceed 90° or be less than 30°—and one flank of the series ought to be close to the meridian[6]. But I would admit...deviation from both these rules if I were sure of thereby saving the erection of one or more towers. ...
>
> I want plans on a scale of 6 inches to a mile—sections on the scale of 24 inches to a mile—descriptive drawings and written descriptions, of every natural height...likely to serve the purpose of a station—...the extent of view at the time of maximum refraction (this varies from midnight to sunrise, and is generally about 3 o'clock). ... Are there any buildings likely to obstruct the view ? ... Plans and elevations of the tops of such buildings, shewing the difficulties ...to be surmounted in making platforms. ...
>
> When there are no natural heights, I want an account of any artificial heights, mounds, forts, temples, towers, or other buildings, ... whose local situation holds out a prospect of

---

[1] SG.'s instructions, 1–5–32, DDn. 267 (125–8). [2] Lancaster-Jones (60). [3] Fdbk. M 527 ; DDn. 275. [4] DDn. 402 (57–81), 24–7–40. [5] MRIO. 16 (44), Sketch of Kaliānpur meridian, Dholpur to Siwāliks, sgo. 15–10–32. [6] of Kaliānpur, 77° 42′.

> answering as a station. North of Delhi, I fear, towers must be built the whole way to the foot of the mountains, but if...the series bends over to the east it will come sooner on elevated land than by remaining to the west [pl. 4].
>
> A description of the...country between Delhi and the mountains at the back of Saharanpoor and Hurdwar is wanted; it must contain remarks on the general height and closeness of the trees and other obstacles, so that I may judge of the height necessary to be given to the towers. If those trees are not private property I shall cut them down[1].

At the end of the year Rossenrode was despatched to bring the approximate series on which Boileau had failed from Sironj to Fatehpur Sikri. This was the sort of work that he had long been used to, and Everest had every confidence of his success [III, 499]; "To a person of your experience I need not give very detailed instructions. You will report progress every Monday to Mr. Olliver".

Olliver was sent up to Agra to reconnoitre southwards from Fatehpur Sikri, and keep touch with Boileau to the north. The two last-joined engineer officers, Waugh and Renny, joined Rossenrode for practical instruction;

> I do not intend, however, to attach them to those operations, or to give them any responsibility, for the obvious reason that Mr. Rossenrode is a veteran in that way, and as far as practice is concerned is much more able to communicate information than to receive it[2].
>
> It was left entirely to themselves to stay with Mr. Rossenrode's party as long as they had anything to learn, or quit as they thought proper, and it was most gratifying to find how entirely my confidence was paid, for they not only remained as long as the party continued in the field, but engaged actively in the execution of the work[3].

To stimulate their taste for geography, they were sent in advance to explore the country between Rohtas and Amarkantak [270-1] and then joined Rossenrode at Mao, about 80 miles south of Gwalior.

In addition to laying out his triangles, Rossenrode was to sketch in the country as far as possible, noting "villages...or other remarkable objects";

> Be sure about their names, so that no uncertainty may exist in the intersection or in the orthography. It is my object to make the topography of the tract...within the series as complete...as possible. ... Intersect any objects which will enable me to lay down the courses of rivers, and their junctions with others, ranges of hills etc., etc. Do not make any delay...for these matters, but avail yourself of spare time which would otherwise be thrown away[4] [61].

He asked the Resident at Gwalior to help;

> It is the special desire of the Hon'ble Court of Directors and of Lord William Bentinck's Government that all towns, forts, and villages, which are visible from the principal stations, ... should be accurately laid down, which, with very few exceptions, is not to be accomplished without having a flag...properly erected within the place. ... As it is immaterial what kind of flag is used, provided the staff be straight and the site well chosen, perhaps the Maha Rajah's Government will consent more readily if the flags be provided by the Minister at Gwalior of a pattern selected by himself, and be paid for by me [152]. ...
>
> A green flag in the Nizam's territories facilitated the introduction of my parties with flags and instruments into most of the principal fortresses and towns to the southward[5].

Rossenrode started on 1st February 1833 at Everest's station Pardho, 15 miles north of Sironj, and by September had brought up a continuous chain of triangles to Pagaro, just south of the Chambal River, the north boundary of Gwalior [pl. 4],

> where he was obliged to desist on account of the heavy tropical rains. ... Several other hill stations capable of being arranged into a series of triangles were also selected by Mr. Olliver north of the Chambal, but in these no angles were observed, and as to the work entrusted to Captain Boileau, though it conveyed a general notion of the features of the country, ... yet it gave no decided information whatever[6].

Everest himself left Calcutta on 24th December, travelling via Mirzāpur to Saugor, which he reached on 3rd March. After visiting Macdonald on the Budhon series, he went on to meet Rossenrode at Kolarus, near Gugbara, on 28th March. Then marching north through Gwalior along the general line of proposed triangles he reached Fatehpur Sikri on 10th, and Muttra on 13th, April[7].

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[1] to Boileau, DDn. 267 (159-64), 13-10-32.

[2] DDn. 283 (189-90), 26-10-32; cf. instructions to Waugh, ib. 267 (169-73), Nov. 1832.

[3] Report, 21-8-39 (48-51).

[4] DDn. 267 (166-9), 6-11-32.

[5] DDn. 287 (5-6), 29-6-33.

[6] *Meridional Arc* (xiii).

[7] DDn. 283 (199-201), 15-11-32; ib. 321 (a), 4-3-33.

Boileau's work was reasonably satisfactory as far as Delhi, but he did nothing of any value to the north ; "when the stations fell into the plains, there was a total failure, both on the part of that officer, Mr. Olliver, and everybody else". Everest was forced to recognize that, except for Rossenrode's work to the south, everything would depend on his own personal reconnaissance[1]. He writes to Rossenrode from Fatehpur Sikri describing the country ;

> From Pahargurh there is, as far as I yet know, no direct road to Futtehpoor Sikri. The reason of this is that the Chambul is a very formidable river, not only on account of the depth of water, but because of the ravines which for miles together have deeply cut the soil into actual mountains and valleys. I passed through them by moonlight, and some of these earthy hills and ridges scale at least 200 feet high ; they may be less, but they are very wild and the passes between them very intricate [II, 28 ; IV, 222].
>
> The Chambul itself in the rains must be a tremendous stream, the actual bed is very sandy, and there are deep pits and excavations in the sand, which if they were filled with water would be far out the depth of man or beast.
>
> The ford crosses the river obliquely, and for upwards of 100 yards the depth of water takes the horse up to the belly. ... Boats...at the Khetheri Ghat...are miserable articles, but at Raj Ghat I am told they are better. Both ford and ferry are called by the name of Khetheri. There seem to be no quicksands, but where the water is deep the alligators are said to abound. None of my party met with...any accident, but though we started at 5 in the evening, I did not myself reach the Resident's bungalow till 11 o'clock, and the greater part of the people wandered all night, and made their appearance only at daybreak.
>
> I heard of another ford when I was at Pahargurh, nearer the meridian [23 n.5], and dispatched Mr. Peyton to explore it for you. ... We are awaiting Mr. Peyton's arrival at Futtehpoor Sikri, and shall get no money until we reach Muttra. ...
>
> I think you will keep to the west of the meridian, and I wish you may be able to do so, for the limit of the hilly country decidedly takes a N.W. course, and to the eastward of Dholpoor and Fattehpoor there are no hills whatever[2].

From Muttra he deputed Wilcox, who had travelled with him from Calcutta, to join Olliver in working southwards to the Chambal ;

> You will establish yourself either at Muttra, Agra, or some other place in this vicinity, and use the most effectual means your judgement may direct to complete the junction of the two series in a satisfactory manner. ... My Chief Civil Assistant will also remain until the junction has been effected. That having been accomplished, all these people with Mr. Olliver will rejoin me at Seharunpore.

On his march northward he took note of everything that had any bearing on his work, more especially any stretch of ground that might for a base-line [50-1]. He even wrote down to Calcutta for reports and maps showing the work of Hodgson, Herbert, Gerard, and other surveyors [III, 22-3, 29-30]. He reached Mussoorie early in May, and reported later that

> my expectations regarding the approximate series have not been realized. ... The failure is attributable—
>
> 1st. To the unexampled haziness and drought of the season — 2nd. To the extremely flat and difficult nature of the tract — 3rd. To the sickness of the people, and the serious disasters which occurred amongst them, from heat in one part of the line, and robbers in another [156, 162-3]— 4th. To the want of well-trained men amongst the native establishment.
>
> I sent all the remains of my old establishment with Mr. Rossenrode but, instead of 15th December, he did not fairly begin operations until 2nd February, and instead of being at Agra on the 15th April he only arrived there on the 13th September. Mr. Olliver, whom I left to carry on a part of the upper series between the Chambal and Delhi, had with him only...untrained people, ... and he describes them as being of little use.
>
> The haziness of the weather precluded all possibility of prosecuting the series through the Doab unless indeed I had had people trained to use heliotropes, which might perhaps be pierced through the mists [27-8] ; but the heliotrope is not an instrument to be used by untrained people, for unless the rays...are properly directed it is of no service whatever. ...
>
> The approximate series of the Great Arc has been brought to the north of the Chambul, and united with Biana, one of the points from which I directed Lieut. Boileau to commence the upper series [29 ; pl. 4].

---

[1] Narr. 1833-4 (9). [2] DDn. 321 (f-g), 10-4 33.

> Lieutenant Boileau has delineated the tract which will be passed over by the upper series, and given...all the elevated spots in the Doab likely to serve as stations between Biana and Saharanpur. Mr. Olliver has taken the angles at some of these stations to the south of Delhi.
>
> I have now called in all the parties to Saharanpur because they are all suffering (particularly the people with Mr. Rossenrode) from severe fever, ... and I purpose, as soon as the health of my people will allow, to take the field myself, in order to determine on the spots best suited for the measurement of a base-line of verification, and for the erection of the towers requisite to carry the series across the Doab.
>
> As far as I can at present judge, the valley of the Dhoon is likely to afford the best ground for the measurement of the base, but as the grass is very high there, and the tigers numerous, it is necessary that I and my assistants, as well as all the followers whom I take with me to explore, should be mounted on elephants. ...
>
> I expect to have the base-line measured by the end of January 1835 at farthest, and if by that time the towers in the Doab are all erected the two remaining sections between Seronj and Saharanpur may be completed in 1836[1].

He writes to Shortrede from Mussoorie ;

> In the spring of next year I shall, if the Supreme Government consents, carry the series of the Great Arc into the heart of the northern mountains as far as it will go in a direction due north. These splendid snowy peaks rise like an impassable barrier, but from what I have seen as yet I judge that I can turn their flank on the west side[2].

Government did not approve this northward extension till the following year [*inf*].

AGRA TO DEHRA, 1833–4

At Muttra Everest had asked the Commissariat to make up "portable scaffoldings and flagstaves" for the selection of stations across the plain [28] :

> I have got people to carry the greater part of these articles on their heads and shoulders, and for the heavy weights there are 3 elephants. ... The erection of these portable scaffoldings and flagstaves was successfully brought into play by me on a smaller scale in selecting the Telegraph stations [III, 270–1]. My object is to spare the trees as much as I can by marking out the identical ones which obstruct the view, and cutting them down, by which means I hope to reduce the average height of my towers below 40 feet [82]. ...
>
> His Lordship in Council declines sanctioning my mountain operations until the Great Arc is finished [*sup*][3].

Leaving Mussoorie on 2nd November, he spent ten days in the western Dūn choosing a suitable site for his base-line [51]. He then marched down to Muttra accompanied by "Boileau, Olliver, and three sub-assistants—4 elephants—42 camels—30 horses—and about 700 natives", a formidable cavalcade [174].

> On my journey downwards from Saharanpur I fixed on the site of the station at Begarazpur, ... selected the old mosque at Bulandshahur, fixed the site of the Chandaos station and that at Noh, and reached Muttra on the 5th December [pl. 4].

All the material and stores required were delivered the following day "with the exception of the great mast for the instrument, and certain of the blocks which were still in the arsenal under the hands of the artificers".

> The scaffolding materials would...be required to accompany my camp from the moment of my arrival at the first station in the plains, but...there was manifestly no inconsiderable portion of work still to be done in the hill stations. I left the portion thus divided off at Muttra...under Mr. Sub-Assistant Murphy, a person of practical mechanical skill ; and, selecting from the motley crowd of my recruits all such persons as were skilful at tying of knots, and thatching, I placed them under Mr. Murphy's guidance, with orders to drill and initiate them, so that by the time they were wanted, their village rust and uncouthness might be more or less mitigated [120, 404, 408][4].

Transport was supplied by the Commissariat.

The team which Everest now had for laying out his triangles from the Chambal River to the last hills near Delhi, and then across the Jumna plain to the Siwāliks, a distance of over 100 miles without the vestige of a hill, was as follows. Olliver and Rossenrode, old and experienced — Wilcox and Boileau, topographical surveyors of some standing — Murphy, a warrant officer from the building department — Clarkson, Kallonas, Martin, Keelan, Mulheran, Radhanath Sikdar, Dove, and Terry, young men recruited during the last two years, with no experience whatever — Lawrence Hill, a young engineer officer who got leave from Delhi to join the adventure.

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[1] Masuri, 15-9-33 ; DDn. 286 (61–9). [2] DDn. 323 (53–4), 16–10–33. [3] to Wilcox, 10 & 29–10–33 DDn. 321 (41–2 ; 62–3). [4] Narr. 1833–4 (41).

The general plan was that Rossenrode took charge of the forward signal parties, the selection of the actual observation points, and any structural alterations required.

Wilcox was sent south towards Gwalior, with Clarkson and Kallonas, to connect with Rossenrode's stations of the previous season, and then to turn back up the selected line, observing at stations along the eastern flank. Boileau, with Dove, supervised supply arrangements from Agra, joining Everest later.

Everest himself started from Bayāna, about 8 miles south-west of Fatehpur Sikri, and worked the series northwards, testing the stations for intervisibility, rejecting those that did not prove satisfactory, and observing at least two angles in every triangle. He kept with him his Chief Civil Assistant, Olliver, and the smart young Bengali, Radhanath Sikdar, who recorded observations and made himself useful in other ways. To Wilcox he writes on 5th December ;

> You will proceed to Dholpoor on the 10th...to select a station to connect with Pagaro, Karapahar [or Gurjapahar], and Oosirah [pl. 4]. ... When you have selected your station, direct your heliotrope as well as you can to Pagaro, Karapahar, and Oosirah by intervals, so that each may in turn get a glimpse of it, and on no account lose a moment in lighting two large fires at the station at 8 o'clock, keeping them burning an hour or longer if you can. The intent of these measures...is to let the distant parties know where you are.
>
> When you have got a sufficient number of angles (3 will suffice), ... go to Karapahar, and then to Machi, to observe the angles in like manner, to the southern and northern points of connection. I shall go from Agra to Biana ; parties will leave this on the 7th for Oosirah, Karapahar, Pagaro, and I shall place a party at your disposition when I reach Agra.

Clarkson was sent to Pagaro :

> You will put up a flag on the centre of the station, and wait there until you see either double fires or a heliotrope on the hill near Dholpoor which Captain Wilcox is going to select. When you are quite certain of having seen Captain Wilcox's station, you will put up a heliotrope between it and the centre of your Pagaro station so that he may see it. Keep your heliotrope two days in that direction, and then put it up on the ray to Karapahar, keeping it there two days after you have seen either Captain Wilcox's double fires or heliotropes.
>
> When you have had the heliotrope two days after Captain Wilcox's arrive at Karapahar, leave Pagaro and join my camp[1].

Everest himself left Agra on 13th December to work north through the low hills which stretch through Bharatpur and Gurgaon between Fatehpur Sikri and Delhi.

> What may be termed the elevated plateau of Central India terminates on the northern side with the high lands in the vicinity of Gwalior, where the valley of the Chambal...commences. This valley is bounded on the north by a range of old red sandstone. ... Further northward...there are detached ranges and isolated hillocks cropping out. ... The last of these, commodiously near to the direct line of the meridian of the Great Arc Series, is Usira, after which...they recede to the westward, ... inconvenient...for the...triangulation.
>
> It was therefore absolutely necessary to have the stations of the east flank of the series beyond Usira in flat land, totally devoid of all natural elevations, whilst the western flank rested on the yet remaining hills. ...
>
> Beyond the sandstone heights near Delhi, on which the last hill station, that of Pir Ghyb, is situated, the stations of both flanks of the series were to be selected in the flat lands of the tract called the Doab, which is comprised between the rivers Ganges and Jumna. This is a wide extended plain remarkable for—the richness of its soil—its abundant population—the scorching heats of the winds which blow over it...from March till June—the deluging and almost incessant rain which falls in the four succeeding months—...and the universal deadness of level of its surface [pls. 1, 3, 4].

This dead level continues for miles and miles, with one village after another hemmed in with closely clustering bamboos and fruit trees [158–9].

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[1] DDn. 321 (70–1) 3-12-33.

> The whole tract, though...totally devoid of all natural elevations except loose heaps of sand accumulated by the wind, ... has yet many elevated earthen mounds, and partially occupied or abandoned sites of villages or forts, which appear to have been raised by the inhabitants in periods gone-by as a protection against inundation or external violence.
>
> The smoke...which, particularly in the cold season, envelopes the villages and clings to the groves surrounding them, that arises from brick and lime kilns and conflagrations of weeds — the clouds of dust raised by herdsmen and their cattle in going out to graze in the morning and returning in the evening—by travellers and processions of men, carriages, and cattle, proceeding along the divers roads for business or pleasure—and by the...wind—...form... obstacles which it is only possible in very favourable circumstances to surmount.
>
> Between Aring, near the south bank of the Jumna, which appears to be the lowest of my principal stations in this alluvial formation, and Nojhili which is the highest [pl. 4], there is a difference of level of 268 feet, which gives an average ascent of about 20 inches per mile. ... The rise from each station to that immediately north of it is marked and unmistakable. ...
>
> The methods of selecting stations which had been resorted to in hilly countries (and none of those at my command had the slightest notion of any others) would not now serve the purpose, ... and it was absolutely necessary that I should undertake the task myself for, ... besides turning to most advantage the highest mounds which were scattered here and there, permanent artificial elevations must be constructed sufficiently solid and firm to admit of the observing instrument...being used at the summits with efficiency.
>
> As such elevations must necessarily be costly edifices of masonry, the locality of each must be well and truly determined beforehand. ... It was quite requisite therefore actually to observe at least two angles of every triangle to within a minute of the truth, in order to determine that every ray passed clear of obstruction. ...
>
> To this end I designed a mast of seasoned timber 35 feet in length, consisting of two parts which could be firmly united by iron bands when necessary. ... The lower 5 feet were to be buried in the earth, leaving 30 feet above ground. At the summit was a circular table of 40 inches diameter, to be occupied by the instrument on its stand ; at the height of 20 feet an iron ring was applied with four dead-eyes for as many stay ropes, and a like number of antagonizing struts adapted below[1].

Under the original design this observation mast was to be completely isolated from the observer's platform and scaffold, but when first erected at Karol it was found to vibrate at the slightest breath of air. It was necessary to brace the mast to the outer posts of the scaffold with diagonal bamboos, which gave sufficient steadiness provided that there was no moving about whilst observations proceeded. The whole contrivance had to be dismantled at each station and re-erected at the next. Everest records that at Karol

> I had no person to render me the least assistance in putting up the scaffolding. ... I superintended its erection and the subsequent dismantlement...myself, and when it was removed to the next station...I did the like. But the natives...had begun to take a pride in understanding the operation and performing it unassisted, and in the end there was hardly one...who did not feel himself called upon to execute the work without troubling me[2].

For his distant signals Everest had thirteen masts 70 feet high for which stout bamboos were specially brought up from Calcutta ;

> an upright post of seasoned timber ; ... superstructure of bamboos firmly linked together ; ... a pulley fixed at the top...raising a bamboo staff in a horizontal position to the height of 70 feet, ... which bamboo, being supplied with a sway rope at one end, and bearing an ignited blue light at the other, enabled me to have the latter displayed at a further height of 20 or 25 feet above the top of the mast, ... a brilliant light at upwards of 90 feet above...the ground.
>
> Having taken measures to provide carts for the transport, ... I divided them into two detachments, and...directed one detachment to proceed along the right flank, and the other along the left. ... Each cart, on delivering its load and obtaining a receipt for the same, was to be sent back that it might be paid up and discharged[3].

Extracts are now given from reports and letters telling of the schemes, devices, and disappointments, by which the work proceeded [pl. 4]. Starting from Bayāna, near Fatehpur Sikri, Everest visited in turn

> Alipur, Badhoni, Aring, Rasia, Chapra, Pat, Meoli stations, determining the most eligible sites, erecting a sufficient platform of stone, and observing the necessary angles at each before leaving

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[1] Narr. 1833–4 (49–51). [2] ib. (48–54). [3] *Meridional Arc* (xiii–xvii ; pl. 24) ; *GTS.* II (ii, iv–A).

> it, and on the 7th January I marched towards Bahin, the first station in the plains at which I expected to encounter obstruction.
>
> At quitting the Mooli hill...I was about to make my first essay in a new career, wherein all my former experience would avail me but little. ... The plan which I had designed was still but a floating project, and might be found in practice utterly abortive and inapplicable[1].

The general scheme was to visit the most promising sites in turn, working from a stone platform or the high scaffold. The signal parties were posted on the most likely points at suitable distances, and fired blue lights, or showed heliotropes, at stated times, so that their sites might be intersected.

Everest writes to Kallonas on 19th December, signing himself "your obedient servant" as he never failed to do, however petulant he was feeling ;

> You have detained my party 3 days here looking in vain for your heliotrope, and I intend to hand you up to Government...as your shameful negligence and misconduct deserve.

Martin, on the other hand was commended, Olliver writing on the same day ;

> The Superintendent desires me to say that your blue lights were observed this evening, and that he is obliged by the expedition which you made, and your alacrity in obeying his orders. Your heliotrope was not very well directed ; you must learn to do better than that. You will proceed immediately to join the camp at Kalapahar near Alipur[2].

Boileau prepared the Secundra tomb for intersection, reporting that

> a 22 feet flagstaff, with ropes and flag complete, was yesterday procured from the Commissary of Ordnance, and was this morning erected by me in the centre of the west face of the upper storey of the Emperor Akbar's tomb at Sicundra in the presence of Captain Boileau, Executive Engineer at Agra [117–8], who agreed...that any one of the pillars of the s.w. cupola might easily be removed should it in any way interfere with the rays from the station[3].

and Everest promptly replied ;

> My party left Biana this morning, and will be at Kalapahar tomorrow. I shall stay there no longer than I can help, and on the 22nd, 23rd, or 24th, shall probably be on my way to Torasnath. ... The evening of my arrival I shall light two large fires at my station, for which please keep a look out [89].
>
> I wish you to burn a dozen blue lights at intervals of $\frac{1}{4}$ an hour...at Sikandara. Do not commence burning until either you have seen my double fires at Torasnath, or have some certain intelligence that I am on the look out. If you see the double fires, allow $\frac{1}{2}$ an hour to expire after their first blaze before you burn your first blue light. ... If you can lay down the approximate position of Sikandra station it will assist me. ... Send it to meet me at Torsnath. ...
>
> I indented on the Commissary of Ordnance lately for 100 blue lights ; take a dozen of these if ready ; if not, get some made up as quick as possible [III, 247–8][4].

To Rossenrode, in advance, on 21st ;

> Proceed to Aring near Muttra, and select a station for the large theodolite[5].
>
> I judge from Lt. Boileau's report that the only place likely to answer there is a high building within the gurhi, but as Lt. Boileau has never been in the field with the large theodolite, his report is not sufficiently explanatory. ...
>
> When you have done what is necessary at Aring, go to Barsana near Manpur H.S., and select a station which shall have a view to Aring, Rasia, Chupra, Bahin, and Noh [pl. 4].

On the same day to Boileau ;

> I shall be at Torasnath on the 23rd, and shall light my double fires the same night, provided I can get wood in plenty, for which I shall strive hard.
>
> The blue lights you sent...are composed partly of mud, and at the bottom nearly a pound of solid earth remained. They are a great deception, and emit a vast quantity of smoke but little or no light. I hope those you burn...at Sikandra will be of first-rate quality.
>
> P.S. If the fires are not lighted on the 23rd, you will be so good as to conclude that there is some accident, and look for them on the 24th[6].

To Murphy from Aring, on 27th ;

> I shall want a high flag staff at Bahin on the 1st January, and the portable scaffoldings at Bahin on the morning of the 7th. I shall want the high flag staves at Karol and Noh on the morning of the 6th. ... Be so good as to see they are effected, cost what they may, for a day's delay to my progress at this season of the year costs more than the hire of 500 hackeries [bullock carts]. I am disappointed at not seeing you at Aring with the materials, and am sorry to think you are amongst the slow coaches.

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[1] Narr. 1833–4 (44–5). [2] DDn. 321 (74–5), 19–12–33. [3] DDn. 331 (70), 19–12–33. [4] DDn. 321 (74–6), 20–12–33. [5] for use in the later obsns., not on this reconnaissance. [6] ib. (79).

> I shall probably get over Aring without the high flag staff. I have taken most of the angles, and shall build all I want tomorrow, bricks and mortar having been got ready since 12 o'clock to-day. I go from here to Rasia on the morning of the 29th ; you must meet me at Bahin on the 7th with the whole establishment[1].

Bahin was 8 miles south of Pahera :

> I do not like this station and shall be very sorry if I am obliged to adopt it. Pahera and Kaserna are both preferable, being higher, and affording a much more substantial basis for any tower we are necessitated to build.
>
> I heard your elephant had been stolen. If I can help you in any way to recover it, be assured of my doing my utmost. The Magistrate and Commissioner are very civil, and we are becoming great friends[2]. ...
>
> Bahin was not found to answer. ... After a trial of 6 days I removed to Kaserna, 3·49 miles to the north of it. This would have perhaps answered, but was also abandoned as inferior to Pahera, which is 3·28 miles further north. A square pile of stones 10 feet high was erected at Pahera...which enabled me to finish the observations to Karol by night, and all the other surrounding points being hill stations...except Noh, which was left for Captain Wilcox. ... I marched on the 17th January to Karol, and arrived there on the following day[3].

Having left Bahin for Pahera, Everest writes to Keelan, forward at Deri ;

> You are mismanaging sadly ; when instructed to turn your heliotrope to Bahin, you turned it to Pahera, and kept it there. When instructed to turn the heliotrope to Pahera, you will not do so, and I have been straining my eyes to pieces yesterday and to-day, and all my people have been worried to death in trying to catch the rays from Deri. I left Bahin the morning after I got angles with your heliotrope and came to Pahera yesterday. I suppose you are still directing it to Bahin, but you might as well turn it to the moon.
>
> Now mark what I tell you. The heliotrope is always to be directed to the station where the principal instrument is, but if any other heliotrope is seen by you, you must turn it towards that other heliotrope occasionally only. Three times, with an interval of half an hour between each, you may turn it for 5 minutes to any stray heliotrope that shows itself perseveringly. ...
>
> You directed your heliotrope so well from Torasnath, and made so admirable and clear beginning that I am quite sorry to find fault with you, but you must mend these defects, for I cannot pardon neglect or inattention[4].

Again on 17th ; "I am sorry to say you have mismanaged sadly of late, and are becoming little better than Mr. Kallonas and Mr. Clarkson" ; and Olliver wrote to him that "the Superintendent,

> being about to hand up to His Lordship in Council some of the young men who have been shamefully negligent in the management of their heliotropes, ... had hoped to mention your name as an honorable exception, but your mismanagement has been so glaring of late, that you will also be reported amongst the incorrigible[5].

Murphy was amongst the angels and Everest writes to him from Karol ;

> I saw nothing of the Pahera flag this evening, but at the appointed hour I saw all the blue lights in succession beautifully bright, and elevated far above the village of Chandut. The last blue light was seen distinctly by several spectators at the bottom of the scaffolding, one of whom was Radanath[6].

Olliver failed with his blue lights at Kot ;

> Two...burned well and long, the others were pure trash. It is quite a mistake burning so early and so quick. Murphy's blue lights, which did not commence until 8, and were burned at 20 and 25 minute intervals, were seen with the naked eye and the last...of all was seen by several spectators at the foot of the scaffolding. They got brighter and higher as it got later [000]. ... Moreover Murphy's long intervals furnished time to change the zero without any hurry-skurry, or risk of tumbling through the bamboos and burning one's hair and eyebrows. ...
>
> As the scaffolding is up, I will try your position of Kot, and...wait here two days longer. If this reaches you in time to enable you to get up a high pole at Kot, commence your blue lights at 8 o'clock, give me rational intervals of 20 and 25 minutes, and never mind about sending me notice, for I will...be on the look-out for you both the nights of the 25th and 26th. I send half-a-dozen blue lights, and...the sooner you blaze the better[7].

He writes to Wilcox who was following up in the rear, constructing platforms and marks for the final observations that would be made the following year ;

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[1] DDn. 321 (82-3). [2] ib. (90-2), 11-1-34. [3] Narr. 1833-4 (46-7). [4] DDn. 321 (96-7), 14-1-34. [5] ib. (98-9), 20-1-34. [6] ib. (102-3), 24-1-34. [7] ib. (103-4), 24-1-34.

When you leave Biana...go to Usira hill, on which select a station for the final work. Be most careful in getting where the station mark can be engraved on the solid rock of the hill, and round it built a pile 14 feet square at top and from 2 to 3 feet high, the sides lying north, south, east, and west, putting a centre stone at the upper surface duly above the mark on the rock by means of a plumb line, or by two instruments placed at right angles to each other. It does not follow that the station which you fix for the final work must be the same as that for the approximate work[1].

I have just arrived at Delhi. Your angles have been received.

There is but one way that I know of clearing the ray. Lay down the positions of the two places correctly, and calculate very accurately the angle which the ray makes with any other ray. Lay your instrument in that direction so found, send a person on with flags, which you must place in the line from your station. Cut down the intervening obstacles, and then burn blue lights at the top of as high a pole as you can get. ...

The labour of clearing these village stations is quite terrific, but it is to be accomplished by perseverance[2].

He found the hills were now sheering towards the west ;

Previous to leaving Pahera I sent a party under Lieut. Boileau to explore the sandstone range to the westward...trying whether the series might not be carried further along those highlands, for the advantage of natural heights is so obvious that it was a great object...to cling to the hills as long as it was practicable. This expedition ended in failure[3].

He writes to Olliver, still detained at Kot which was later be abandoned ;

It never rains but it pours. 100 gallant blue lights clothed in parchment came in from Agra this morning. Did I not tell you the only way of making your friends serve you is to be independent of them[4] ? ... Several high trees...would effectually obscure a blue light, and I would cut them down without any commiseration if I could pitch on the obnoxious objects, but it is cruel work hacking and hewing, and finding in the end that we have destroyed trees which did not stand in the way [159–60]. ...

We are obviously in a hobble, from which sheer good fortune only can bring us well out. It seems to me in vain for you to burn blue lights without our knowing something accurate about the ray, and the only way of doing that is to set steadily to work with a minor series, which I shall commence on my side as soon as I can put up my instrument on the scaffolding, and you had better commence on your side as soon as you have pitched on the most probable spot for a station. We shall meet then about half way, i.e., 8 miles from here, and then only we shall know where to look for the blue lights. ...

We are clearly, too, in a hobble about Dehli [*sic.*]. The high land to the north-west certainly obscured the Dehli hill, ...and only night refraction will get us over the difficulty [III, 235]. The whole of that ray up to the high land...was seen this evening, but nothing beyond. ... In fact, this Gulistan, or bed of roses, is like to be a bed of torment to us, for it is lower than all the country to the north...by at least 20 feet, and nothing but the khadir[5] of the Jumna enabled me to see it from Karol.

P.S. It is in vain to hurry or distress ourselves. We must set steadily to work about this ray and put ourselves leisurely to the wheel. Fortune, like our friends, will help us when we are independent of her aid, and then she will be devilish kind[6].

These tiresome delays forced Everest to devise a better way of locating his stations—ray tracing ;

The station of Bostan was selected by Mr. Olliver haphazard. ... Fortunately it was a very felicitous selection, but, previous to seeing the blue lights on the night of the 24th January, I had no notion of the direction in which they would appear, because no ray had been traced out, as was afterwards the practice. ... The station of Deri, ... as well as the Kutub, furnished a never failing landmark for laying down the position of the new station, and the method of tracing rays being then unknown except by minor triangulation, it was considered an unnecessary source of delay.

The Bostan station furnished the first occasion of the necessity of tracing a ray. ... I sent Mr. Olliver to select a station in a direction which I pointed out, and detached Mr. Sub-Assistant Murphy to carry on a minor series of triangles to the site chosen.

Mr. Murphy, though he had hardly ever used a theodolite before, ... acquitted himself most ably, but this result was anticipated, for before his triangles were finished the Dateri

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[1] DDn. 321 (88-90), 12-1-34. [2] ib. (133-5), 9-2-34. [3] Narr. 1833-4 (48); Boileau's report 30-1-34, DDn. 331 (21). [4] from Karol, 25-1-34, 321 (105-6). [5] low scrub covered ground liable to flood. [6] from Bostān, 29-1-34 ; DDn. 321 (110-1).

> blue lights were seen by me on the afternoon of the 5th February. Though Mr. Olliver was the ablest practical person at that time under my orders, the observed angle differed from that which he had intimated to me by the enormous quantity of upwards of 14 degrees.
>
> Though alone at the instrument without a person to assist me, I commenced a similar minor series, with a view of tracing out the ray to Ramdhoara, but as I was obliged to return every evening before dark to look out for blue lights, this operation was likewise anticipated by the appearance of the heliotrope at that station before my work was completed.
>
> It was plain...that the minor triangulation must be superceded by some more expeditious method, and...such method I accordingly devised, ... on which...Mr. Murphy again...met with complete success in a matter perfectly new to him[1].

By the substitution of a rapid perambulator traverse for the laborious minor triangulation, the running of such ray-traces between two stations that were not mutually visible became a practical proposition, and its general adoption greatly facilitated the laying out of triangles across this flat tree-covered country [79].

Everest now sent Rossenrode forward to the Delhi Ridge

> to select a station to connect with Deri and my points east to the Jumnah. The station must be such that I can put the large instrument upon it. The station flagstaff, the Pathan Mosque, and the old ruin in Mr. Frazer's grounds seem to be the most eligible spots[2]. Mr. Frazer has consented to my using the ruin. I send a note for the Brigadier asking his permission for you to examine and occupy the flag station. As to the Pathan Mosque, see what capabilities it affords, and whether it can be made strong at a little expense, and whether the priests will allow of it.
>
> Turn your heliotrope to Gulistan [pl. 4, Bostan], angle 63° nearly with Deri, but I will turn my heliotrope to you, and you may then get the ray exactly. Make haste in giving effect to this, otherwise you will detain me[3].

and on 30th January :

> My heliotrope will be up this evening, and directed towards the Delhi flagstaff as nearly as I can do it. If you see it there will be an end of the question. ... If not, you may conclude there is some high land intervening, that is to say, provided you are awake and at your post[4].

and again two days later ;

> I saw the Pathan Mosque and the whole of that hill last April, and thought then...that it is a nasty place. Perhaps, however, it may turn out in the end to be the only place likely to answer. ... But there is another hill about 5½ miles s.s.w. of the flagstaff, on which Mr. Olliver went last June, and I am equally determined to get that hill before I leave my present camp, so that I may...judge for myself when I get to Delhi, without the necessity of coming back here. ... The bearers go with a flag and heliotrope which you will be so good as to put up on Mr. Olliver's hill. ...
>
> There is immense difficulty here in laying the heliotrope, for I have too much to do to superintend it myself. ... but we must do the best we can, and as soon as other difficulties are got over, my heliotrope will be turned all day long to your two stations[5].

He writes to Olliver on the same day ;

> Mr. Rossenrode has got entangled amongst the nasty buildings on Mr. Frazer's hill. ...
>
> On the night of the 30th I had blue lights burned both at Karol and Bulandshehur ; the former I lost altogether ; of the latter I saw two burned at 20 minutes between, and I took the angle to one of them. ... Last night I burned blue lights again at both those places ; I saw all the Karol ones and took angles to three of them, but the Bulandshehur ones were lost altogether, for a west wind set in and turned the whole sky into pea soup. ...
>
> Be prepared against the clearing up of this mist, for it certainly will not last much longer, and even now seems clearing away. It will, perhaps, be succeeded by a few fine days, of which we must make the most[6].

and to Rossenrode again ;

> That large ugly town is so full of smoke that I quite despair of even seeing the Pathan Mosque, or the flagstaff tower through the haze, for even the Juma Musjid is seldom seen from here. All this day I have had this heliotrope directed towards the flagstaff tower, as computed[7].
>
> Mr. Olliver and Mr. Murphy are both ahead, working out the ray to the northern station which, according to the plan now established, is done by a minor series of triangles closing in the two ends of the line. The mode is most certain but rather tedious, and your aid would

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[1] Narr. 1833–4 (55–8). [2] Wm. Fraser's house was the historic Hindu Rao's house of 1857. For accounts of the old buildings on Ridge, v. Fanshawe, Bullock ; Sarkar. [3] DDn. 321 (104–5), 25–1–34. [4] ib. (112–3). [5] ib. (116–7), Gulistan, 1–2–34. [6] ib. (117–8), 1–2–34. [7] Stand on the Ridge and try to make out the President's House across the city. Wait for the rain ! ! BHP.

> be invaluable to me, for I cannot leave the instrument, and am obliged to remain and compute the data which other people send in. ...
>
> Mr. Murphy's work with my little instrument is the very best secondary work I have ever seen, and he will soon turn out quite a first-rate performer. He is zealous and indefatigable ; works as hard as I want him, never spares himself, and is most correct in all he does.
>
> I intend to carry a minor series...from the Delhi Pathan Mosque station to Gulistan, sides 3 to 5 miles or upwards if the weather permits, and...find out exactly how the ray lies. ...
>
> The Mosque is a detestable building. I am sure I shall never be able to build a pillar on it 4 feet high, with circular stone at top, 48 inches diameter. It will never bear such a weight, nasty rotten old building as it is. Can you not get clear of the buildings, standing on the hill on a pile of our own making, such as we always have in the G.T. Survey ?

and the following day ;

> You are wearing me to fiddlestrings about this Delhi ray. My heliotrope was directed the whole of yesterday at the proper elevation, and at an angle of 55° 6′ with Deri. ... Are you not aware that if a heliotrope sends it rays at a particular elevation in any direction whatever, if it is not seen at the precise spot, it must be seen by going either to the right or left, unless there be some high object in front which obstructs it ? ...
>
> Go to the right and the left, and to the front, until you do see my Gulistan heliotrope, and note how far it is out. ... If you do not take some pains...you will never succeed, and I may be detained here for the next 6 years. It is pleasant enough for you, I dare say, near a grand cozy city, but for me and all about me it is a great nuisance, I assure you[1].

Everest's patience could not hold out ; he called Rossenrode in and writes to Olliver, who was now shewing lights from Dateri ;

> I saw the Bulandshehur blue lights to-night very clearly burnt, as soon as dark, at 20 minutes intervals. It is plain we have a spurt of very fine weather, and if it is as clear tomorrow evening as it was this evening, do you burn 4 blue lights at 20 minutes intervals, as soon as dark. If we are so fortunate as to have no trees in the way, they will probably be seen. ... If it is clear and they are not seen, then the minor series is the only way. ...
>
> Mr. Rossenrode's heliotrope on your hill [Talkatora] has been seen and intersected ; not so on the Pathan Mosque. ... Mr. Rossenrode is misconducting himself, and I have ordered him back to camp. Desire Mr. Murphy to proceed immediately to Delhi, and select a station whence Deri, Gulistan, Dateri, and Mokari, can be seen, and when he has got a point (which I would have rather on the solid hill than on any building)...let him turn his heliotrope towards Gulistan. ...
>
> If Mr. Murphy cannot do without a building, let him try the Pathan Mosque. ... I think the flagstaff tower may be made to answer, but you know I place great confidence in your judgment, and you know the place very well[2].

Murphy's services were not required, and Everest writes again to Olliver three days later, telling that successful observations had at last been taken to Delhi where my brother undertook to burn blue lights [119]. I did not succeed...with the blue lights which my brother burned, but having removed Mr. Rossenrode, ... and sent out Jey Singh and Ressal, khalashis, to take command of the heliotrope, I got the angles with that station most perfectly. ... I have given orders to strike the scaffolding in the morning, and have sent it on to Dateri ; I move on to Deri[3].

Everything went well at Deri, and Everest complimented Dove and Martin, though he continued to pour scorn on poor Rossenrode ;

> I have made short work of the hill stations. The moment Mr. Rossenrode was fairly off, the Delhi heliotropes appeared in full blaze, just within a few second of the spot to which my heliotropes had so long been directed in vain. I had stolen a few rays to the Talkatala heliotrope the day before, though God knows they were grudgingly enough doled out to me, and so I quitted Gulistan about 2 o'clock on the evening of the 6th.
>
> On the morning of the 7th I arrived at Deri, and as there was no Mr. Rossenrode to deal with, but merely a parcel of unsophisticated natives, with the exception of Mr. Dove at Meoli, who managed his heliotrope in a masterly manner, I got over all my work in high style, and quitted Deri this morning.
>
> This morning also I arrived at Talkatala, and still thanks to the absence of my Principal Sub-Assistant, found all my heliotropes duly directed, measured the supplemental angles, and am off to Delhi in the morning to do the like[4].

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[1] DDn. 321 (121–2), 1 & 2–2–34. [2] ib. (122–4), 3–2–34 ; the circular flagstaff tower stands at N.E. end of Ridge. [3] from Bostan, or Gulistan, 6–2–34, DDn. 321 (126–8). [4] ib. (130–3), 8–2–34.

He reached Delhi on 9th February and wrote to Olliver the same day ;

> I am all alone, and have no time to compute at present. I left Gulistan at 4 o'clock in the evening of the 6th, and till last night have been on my legs ever since. You had better try your own hand at computation ; you are quite equal to it ; besides you have Mr. Rossenrode and Mr. Murphy to help you, so it is three to one in your favour. You must look on me as a worker of miracles. ...
>
> The most abominable mischief has been done here. No less than three centres besides the position of the flag, and not one of them bearing the least relation to the rays in which they were observed. Neither is any one in the middle of the building.
>
> There would not have been a better or more solid spot than the gateway of the Khoda Jan Khan ka Musjid, alias Ram Dhoara, which has...been called by us—Heaven knows why—the Pathan Mosque. I shall fix the station in the centre of that gateway ; ... Mr. Rossenrode could not have had an easier task than to have fixed on the centre of the gateway at once. The domes do not interfere with any of the rays[1].

Again on 11th February, overwhelmed by correspondence ;

> This is grand weather to be sure. It will rain, and it will not.
>
> I am building a place like that at Aring [40-1] over the gateway of the Ram Dhoara, and the vile...holiday has completely put a stop to my work, and moreover closed up the Treasury so that no money can be obtained. The clouds have closed up the sun so that no heliotrope can be seen, and it seems a regular combination of heaven and earth to bring the operations to a full for stop a time. ...
>
> I have no place ready for observing yet ; there has been no getting anything done in Delhi. It would be in vain to burn blue lights this weather, and equally vain to begin until the instrument has a place to stand on.
>
> I am overwhelmed with business. No less than 76 letters came in upon me at once when I arrived. I do not know when I shall be able to attend to my own operations again ; it is enough to drive one mad. If I sit down to compute, instantly some person comes in to distract my attention to some other subject, and I make a mistake as the necessary consequence. It took me hours and hours yesterday, and to-day, letters, letters, paybills, accounts, and what not, have prevented my doing anything.
>
> [the following day] I find when I wrote to you this morning, I gave you the angle which resulted from my computation at Gulistan, instead of that at Meoli. ... But when people are coming every instant to distract my attention, I am eternally making blunders. I cannot compute unless I am quite quiet. I find I have made a blunder in the preceeding computations from the same cause[2] [109].

All round visibility from the Ridge was exceeding difficult to arrange, and it was not until the 22nd, after two week's troublesome work and help from Boileau, that Everest was satisfied, and able to leave for Datori. He had in the end to abandon the Pathān Mosque, or Ramdoara, and the final observations were made from the building in Fraser's compound known as Pir Ghaib, which, he writes,

> derives its appellation from a small darga of a mahomedan saint of that name. The observations...taken on the southern dome of the building. Through an aperture in the key of the dome, a mark has been normally placed on a piece of brass inserted in a stone buried in the floor of the lower story ; this mark is [39] feet below the upper station mark. The darga is strongly reinforced with buttresses, and a stage has been adapted to the parapets surrounding the dome so as to isolate the observer from the instrument[3].

Fanshawe in 1902 describes it as an observatory

> which stands on the highest part of the Ridge, ... in all probability the tower upon which a chiming clock was erected by the King. It is popularly known as the Pir Ghaib, or the hidden saint, ... from the underground galleries which connect it with the plain to the north[4].

The building was the look-out tower of Feroz Shah's hunting palace. Not knowing of its adaptation as a trigonometrical station, Bullock writes in 1951 ;

> One of the rooms on the ground floor has a circular hole in the centre of its stone ceiling ; directly over it is another hole in the roof of the room above, and on the top of the second hole is a hollow masonry cylinder three feet high, and 4 inches in diameter. Through this series of apertures there is thus a clear view of the sky from the room on the ground floor[5].

---

[1] DDn. 321 (135-8), 9-2-34 ; also known as Chouburji, or "four towers". Bullock (26). [2] DDn. 321 (138-43), 11 & 12-2-34. [3] *Meridional Arc*, (261) ; the corrected height 39′ from *Trig.* 53 H (1) ; cf. station at Aring [40-1]. [4] Fanshawe (58) ; cf. note on "hidden passage", *Statesman*, 16-11-1951. [5] Bullock (26-7).

In other words, Everest was able to get good all round view from his instrument that was centred directly over his markstone that was buried in the ground floor.

From Dateri Everest called on Peyton and Logan [165, 172] to help in locating stations along the Siwālik range ; Peyton was to go to Hardwār

> and select two stations, one on the Kunkul hill, which is on the west bank, the other on Chandi Pahar, which is on the east bank of the Ganges. ... Your station on the Chandi Pahar should...command a clear view [westward]...for which purpose it would be better...to select it on the west side of the temples. Having done this...find out whether the Amsot or Timli hill and your Hardwar station are visible from each other...by...heliotrope. If they are certainly visible it will save trouble, but if not you must select one or more of the highest intermediate points on the range, and clear the jungle forthwith. ...
>
> Find out by hook or by crook, and fix the directions of the heliotrope at the Hardwar station to Amsot, Godhna, and Bhulsna. ... I will shortly send you up some of my ablest heliotropers with their instruments. ... P.S. A looking glass with a hole cut through the silvering is an excellent substitute for a heliotrope[1].

He was insistent on speed ;

> Make yourself acquainted with all these localities, and be untiring and alert. Don't go to sleep, for we are all grown very active in the G.T.S. camp, and cannot brook the delay of easy-going gentlemen. My last heliotrope will quit Delhi in the course of a day or two. ... I shall send them up to you, and as the heliotropers have been trained to habits of alertness, you will be so good as to set them an example to encourage them[2].

Whilst Everest was hustling northwards past Meerut, testing one point after another in his effort to get symmetrical triangles, and with Boileau and Olliver at their wit's end to satisfy him, he left several of the stations to be occupied at leisure by Wilcox, who, he writes, "still *exercises his superintendence* at Aring in hopeless despondency". The atmosphere grew desperately thick and murky, and many blue lights were burnt to no avail [105–6]. He writes to Keelan from Dholri ;

> You have, of course, not burned any blue lights as yet. The atmosphere has been so hazy that I have hardly been able to see my lamp which is hardly ½ a mile off. The only way is to wait patiently and be prepared for the first favourable opportunity. ...
>
> Meantime employ yourself in raising the mast as high as you can...for without that there is a very poor chance of my being able to see it. There are some very high trees in the direction of Saini...which block up the horizon altogether. I have been lopping some of the highest, and if I could find out exactly which of them lie in the way, I would floor them immediately, but I cannot say exactly, from not knowing the precise direction of the ray.
>
> I have sent out Mr. Murphy to trace out the ray, and then perhaps I shall be able to find out what I require. In the meantime, as I said before, do be patient and watchful, for this is one of the greatest difficulties we have yet had to encounter[3].

It is hardly surprising to find that there was an accident in handling these heavy masts, and Everest writes to Dove on 5th March[4] ;

> I hear from Mulheran that you met with an accident in a fall of the mast, and I send my palanquin to bring you in. You had better therefore return to camp in order that we may look after you. I send out Mr. Martin to give the time to Chitakun when the blue lights are burning, and if you can lend him your watch it will be an accommodation. Do not detain my palanquin, but come back as quick as you can without hurting yourself, for the fine weather is going to begin, and the morning broke propitiously.

and to Olliver ;

> The sun rose very bright and propitious this morning, and I fancy there is another spurt of fine weather coming on, of which we must make the most. ... I have seen the Ramdhoara heliotrope from the scaffolding [000]. If no tree is in the way I expect to see your flag at Saroli provided it is high enough. I expect also to see the Dateri flag. The ray to Saini will give a great deal of trouble, being frightfully encumbered with trees and villages [87]. ...
>
> I think a minor series will not be necessary for the ray Dholri to Saroli, and I only set you about it because it is as well to employ these nasty pea-soup days in that as not. But Lieut. Boileau and I have between us devised a shorter plan, viz., to start from the scaffolding with a perambulator in any direction, and make a chain of as long links as we can, terminating at the station to be found [32, 79]. ...

[1] DDn. 287 (305–6), 27–2–34 ; Peyton's angle-book, 4th Feb. to 11th April ; GBO Comp. M-9/4-G-11-6.
[2] DDn. 333 (28–9), 4–3–34. [3] DDn. 321 (175–6). [4] Dove was back at work by 9th.

> This...will be indispensable in the ray from this to Saini, for it is domineered by some very high trees about 6 or 8 miles off. Mr. Murphy started on this work this morning[1].

Even after the turn of weather things did not go too well ;

> Dholri seems to have been a bewitched place from beginning to end ; I got flags and heliotropes, but something or other happens to prevent my seeing blue lights. I do not know when we shall recover the effects of the first night's burnings in that vile pea-soup atmosphere. All who have gone out since seem determined not to fall into that error at all events, for however clear it is they will not burn at all. When the lights are burned and seen distinctly, either a tree is in the way, or the pole breaks.
>
> Two days ago I sent out Mr. Murphy...to find out the direction to Saini. He has...sent in his work, which is the most complete jumble and confusion imaginable. ... Thus the only fine weather is employed for the purpose of wasting my beautiful blue lights.
>
> I have sent out a positive order to Mr. Keelan at Saini to burn foul or fair, both this evening as soon as dark, and tomorrow morning at 4 o'clock. If the charm is dissolved, I shall see them, but Lord knows, some pole will break, or it will get misty, or the harkara will not arrive in time, or some high tree will be right in the way.
>
> I have been interrupted in writing this letter. The pole broke at Dateri, and the light stood only 54 feet high. Lalu got up and burnt them in his hand as high as he could reach. Mr. Keelan burned last night, and will not burn again till tomorrow morning. ...
>
> I do not know what has become of the digging implements. ... I fear some has been made away with. Likewise the 1,200 fathoms of cotton rope which was supplied about six weeks ago. I cannot imagine where it has all vanished, and everybody is calling out—No Rope ! No Rope ! Give me Rope !

The new system of ray-tracing had proved its value [79] and

> Mr. Murphy's work was reduced to order by Lieut. Boileau, and the ray fell on a high pipal tree about 2 miles off. This was cleared away before nightfall, and this morning at 5...the Saini blue lights glittered above the mangoe grove behind the high mound of Luval. Mr. Murphy's ray was correct to within a few seconds, so that the new method [by perambulator] is as accurate as need be, and much more expeditious than the old.
>
> When you follow the new method, please to draw up the observations exactly as they are registered in the angle book, and be most careful not to substitute A where B should be, for in...that consisted Mr. Murphy's error. ... I can take out the differences myself, and like to trust to my own computations. ... If I had your observations I could compute the ray whilst we are putting up the scaffolding tomorrow.
>
> Mr. Murphy started on the forenoon of the 5th, completed his work on the 6th, sent it to me early on the morning of the 7th. The blunders were rectified by 2 p.m., and by sunset the obstructing tree was felled, and the morning of the 8th the blue lights were seen. The distance is 20¼ miles. ... It...shows how much people can do when they like to exert themselves. He will turn out a very clever and first-rate man, I am sure ; method is all he wants[2].

Hot weather storms come suddenly and with great violence—a lot of dust with possibly a little rain—and a drop in the temperature. They interfered seriously with observations, and Everest writes to Keelan from Begarazpur on 16th March ;

> The storms, I suppose, have deterred you from burning, and you will have acted quite right in refraining ; but now attend.
>
> The storm subsided this morning at ½ past 5. If you had burned a blue light at that time and I had been on the look-out for it, I should have seen it ; but I took down the instrument, and I suppose you did not burn, but went quietly to bed. Is that not so ?
>
> Now, if the storm assails us again at 5, we will wait till it is all over, and if it is succeeded by a calm, you must burn one blue light as soon as the atmosphere appears unruffled, and burn as many after it at 16 minute intervals as will bring you up to ¼ of an hour before sunrise.
>
> If the sky is clouded but the atmosphere free from agitation, you may burn your last blue light at sunrise[3].

To complete observations at Begarazpur, Everest laid on a definite programme for Keelan and Martin, who were showing lights at Saini and Sheopuri, two lights at a given interval from each station in turn[4]. This did not work according to plan, and Everest writes to Keelan after midday;

> You are certainly most irregular. Who but a half-crazy person would have chosen a time when it was blowing great guns to burn his blue lights in utter defiance of my orders, and you

---

[1] from Dholri, 5-3-34 ; DDn. 321 (178). [2] ib. (183-5), to Olliver 7/8-3-34. [3] ib. (193), 16 3 34. [4] ib. (194-3), 17-3-34.

> certainly did this on the morning of the 17th. ... The khalasie tells me you began at 4, when was obliged to hold on with both hands to save myself from being blown off the scaffolding, and neither lamp nor taper could show its nose[1].

Keelan continued to be unlucky [88], and was recalled two days later—"The naik of my escort, Shekh Ahmed, is sent out to take charge of the station and to burn blue lights under instructions which he has received from me [412]"[2].

Continuing to storm and rage at each and all of his assistants in turn whenever anything went wrong—standing to his instrument for many hours through the evenings, and again an hour or two before dawn till 10 o'clock or so—spending the day at correspondence or computations—insisting on his assistants sending in their raw observations so that he might compute them himself—praising—scolding—jeering—mocking—and sometimes patiently explaining—Everest steadily brought his team and his triangles within view of the Siwāliks, and wrote to Peyton from near Hardwār on 3rd April ;

> The instrument will be at Chandni perhaps in the afternoon. Tomorrow you had better turn the Khasrao heliotrope to Chandni. Leave it under charge of a careful person with orders to be most punctual from sunrise till 10, and from 2 till sunset, and then come to meet me at Hardwar. I shall be glad to see you in order to discuss the affair we have in hand. ... Will Chandni connect with Mohan ? If not, will Selimpur connect with Mohan ?[3]

The lay-out of stations along the Siwāliks was exceedingly troublesome ;

> The series quitted the last of the southern hills at the Delhi station. It came on the Sewalic hills at the Chandni Pahar, near Hardwar, which I intended to be the eastern point connecting with the Amsot hill, ... a transferring point for my proposed base. The Amsot hill being, in fact, the only peak visible both from the site of the base-line and the stations in the plains, it was absolutely necessary that whatever point was selected to the east of it, the rays from it to the west and south must be thoroughly unobstructed. ... Chandni Pahar was not found to answer, ... and no fewer than 6 other stations had to be occupied in the Sewalic range before one was found which would serve the purpose. That one...has been called by me the hill of Dhoiwala, which is the nearest village, and about 7 or 8 miles from it in the Dun.
>
> But the ray...to the Amsot station was not unimpeded. It flanked the range of high peaks ; one of which stood so exactly in the line that, though the Amsot heliotrope could be seen clearly by a person standing 10 feet to the south, yet at the only spot suitable for a station it was utterly obscured except immediately after sunrise. The detection and demolition of this impeding peak formed a new difficulty. ... Before the approximate series could be connected with the proposed base...8 points had to be selected, and one high peak razed about 20 feet. ...
>
> In the Sewalik range there are no villages whatever from which supplies can be obtained. No water except after heavy rains—no guides to show the paths if any existed—no names by which the divers entangled peaks are known—and, except at the passes where people are maintained by the State, no vestiges whatever of anything in the shape of humanity.
>
> Wild elephants range...through the ravines...leaving their traces in every direction. They are snared there, these lonely dismal hills being set with frequent pitfalls for...entrapping them. ... Where a vagrant male, or stray female who has lost her young, encounters a passing traveller, he must owe his escape to his dexterity and good fortune, for destroy him they certainly will, if they can. ... As to tigers, it is the regular den of those which infest the Dun ; their own choice place of refuge from that notorious hunting ground. ...
>
> Amidst these and such like difficulties...each of the 8, peak after peak, had to be ascended in vain until the right one was selected. The alarm...spread amongst my followers—the terrific stories...told of hair-breadth escapes—the bragging assertions of some of the sepoys who vaunted the number of cartridges they had expended, and the number of balls they had lodged in the bodies of wild elephants, when in reality they had doubtless been only firing to assuage their own fears—rendered it incumbent on me to be nowise chary of personal exposure[4].

Both Olliver and Boileau shared in this strenuous hunt along the Siwālik range.

On 7th April Everest wrote to Wilcox, whose slow progress away to the south had left him out of the picture for a long time, and acknowledged

> two private letters...dated the 21st and 31st March, written in a hand which it takes me time to read. ... I am terrified to think how many letters lie unanswered and unopened. The receipt of a long letter now makes me shudder.

[1] DDn. 321 (197), 17–3–34. [2] ib. (199–200), 19–3–34. [3] DDn. 289 (1–3), 3–4–34. [4] Narr. 1833–4 (64–70).

> The long delay which you made in the neighbourhood of Noh put you out of my recollection. ... I have no leisure to think of any but those who are immediately under my superintendence. ... Aring to Noh...could not have occupied me two days at the utmost. I sicken to think how long you have taken about it. Pahera to Noh...would have detained me less than 2 days; only the high trees near Pahera seem to have been in the way.
>
> Now—whilst you have been occupied on these two rays—I have advanced from Delhi to Hardwar, having visited 13 different stations, cleared 8 rays, and taken 22 regular sets of angles, all with blue lights which you pronounce to be impossible at this season of the year. ... Generally speaking, blue lights are seen better at this season...than any other. All depends on the degree of attention that is paid, both by him who burns, and him who observes. If you give proper instructions—and these instructions are properly attended to—and both parties be on the alert and watchful—...the blue lights will be seen well enough. There is no fault in the season or atmosphere. ...
>
> In some cases the blue lights at 19 miles off threw as strong a light as the planet Venus, projecting a perceptible shadow. ... But then I have been ever on the watch, my people knew me too well to neglect their business, and not a moment has been thrown away. ... Though weary for want of sleep, and worn out with watching, I have never indulged in rest until all that depended on my immediate exertions was fulfilled ... I have set about clearing a ray at 2 p.m. and observed blue lights through the gap at four hours after midnight of the same day. ...
>
> Where there is no chance of altering the sites of 2 stations, I clear away trees without any kind of remorse, but I make sure of that point first. If at any site used in the approximate series it should appear that the ground is not so well adapted to building as at a little distance to the right or left, I forbear to cut one superfluous leaf[1].

By the first of May he moved up to observe at Hathipaon and Banog and reported the successful completion of the season's work on 12th, thanking Government "for the ample means placed at my disposal"[2]. He writes elsewhere;

> I took the field myself...on the 1st of November [1833], ... and by the end of the following April I succeeded in selecting all the stations—furnished the architects with drawings...of the towers to be erected (seventeen in number[3])—measured all the angles—...and traced out the site of a base-line in the valley called the Dehra Dun. ... The labour was tremendous. ...
>
> Near Bharatpur, in latitude 27° 14′ is the hill station of Madoni, the last natural height which occurs on the eastern flank of the series for upwards of 215 miles of direct distance, so that in proceeding further northward the stations were to be fixed in lands presenting absolutely a dead flat. At Delhi, in latitude 28° 41′, is the last natural height on the western flank, ... further north than which all the stations on both flanks were...to be fixed in the same undeviating plain for upwards of 100 miles[4].

He could justly claim that there was "no instance on record of a symmetrical series of principal triangles having been carried over a country similarly circumstanced"[5].

He now spent the rains at the Park with several of his assistants, computing results and preparing for next season's operations—designs for the great towers—plans for the new base-line—lengthy reports and correspondence. His office staff were housed at Dehra Dūn [166].

OBSERVATIONS: DEHRA TO SIRONJ, 1834–7

After the rains Everest made his expedition into the hills [26] visiting Kederkanta, *c.* 12,540 ft., Nag Tiba, and the Chaur [III, 30; pl. 5], and taking observations to the snow peaks;

> In the end of the following August, I proceeded on an expedition into the mountains with the view of determining how far it would be practicable eventually to advance the approximate series into the northern mountains, so that on my return to England I might convey information on that point, which is one of much interest to scientific men. ...
>
> I returned in the end of October to make preparations for the final measurement of the base-line in the Dun [51][6].

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[1] DDn. 321 (224–31), 7–4–34 from Chandni. [2] DDn. 286 (127–8), 12–5–34. [3] includes 3 converted buildings. [4] Everest (8–9). [5] Narr. 1833–4 (1). [6] ib. (71) angle-book, GBO. Comp. F–17/61; TS., II (11, 331, 349).

He completed the measurement of the Dehra Dūn base-line in February 1835, and then connected it to the surrounding hill stations, Dhoiwala, Amsot, and Banog, whilst Waugh made a second measurement [52].

Becoming seriously ill, he had to abandon his plans for an immediate start with the southward observations, though he sent Olliver and Rossenrode to clear rays towards Delhi. As the towers were not yet ready, all field work was closed down soon after the commencement of the rains.

In October, Jones, a young engineer officer of promise, was sent down with Olliver south of the Chambal, to try and straighten out the triangles just north of Gwalior;

> The stations in the approximate work...were selected in very unfavourable weather, and there was an unsightly bend as it approaches the Dholpur territory. ... This party left my headquarters early in October 1835 and joined me in February 1836. ...
>
> I commenced operations myself early in October, but the deplorable state of my health was for some time a serious drawback to any active progress[1].

Being anxious about his health, and having been under medical treatment the whole of the rains [5, 315], he called Waugh from the Ranghir series to assist in observations, Logan having made a start from Amsot and Dhoiwala. Everest hoped at first to cut out the two stations on the Siwāliks, and connect Banog direct with the northernmost stations on the plain, but this did not prove possible;

> Banog...is the first transferring point connected with the base-line. ... It is a back peak of the range of the sub-Himalaya on which Masuri, Landour, etc., are situated, and is 7,544 feet above the level of the sea[2]. A more eligible point for a station cannot well be imagined for, being the highest eminence on the range, it commands an extensive view, and the summit being earthy and rounded into undulating land, there is an abundance of room for encamping ground. I erected a platform of masonry 14 feet square at top, and cut a road to the station 2·11 miles long, with a slope sufficiently easy to allow the conveyance of the large theodolite[3].
>
> The angles to the two ends of the base, Amsot, and Dhoiwala, were taken in May 1835. In October 1835 I commenced to take observations for azimuth but, my inability to stand at the instrument having forced me to abandon them, they still remain...for further completion. ...
>
> The station of Amsot is on the highest peak of the Sewalic range, ... the only eminence on that range which will serve the purpose of connecting the base-line with the principal stations in the plains. ... Its height is 3251 feet above the sea. ... The formation of the range generally is very friable...and, as large masses...annually fall in from the action of the elements, ... neither this hill station nor that of Dhoiwala can be looked on as likely to endure for many years[4]. On this account I strenuously endeavoured to dispense entirely with the Sewalik range. ... To accomplish this with any regard to symmetry was...quite impossible. ...
>
> Amsot was visited by me...in April 1835. ... Part of the angles having remained unobserved, it was revisited in October and November. ... In both these instances the large theodolite was entrusted to Messrs. Logan and Peyton, the extreme severity of my illness not allowing me to rise from my bed[5].

Leaving Dehra on 22nd October 1835, Everest started out to observe the triangles he had laid out with so much labour, working from the great masonry towers that had now been constructed to his design [82–3]. He had much the same trouble across the *doāb* as before, and the assistants, Keelan, Murphy, and Dove, were kept extremely busy with heliotropes and blue lights.

> On the 11th November I arrived at the tower of Nojhili, which is the northernmost [15]. On the 12th...the large theodolite which was constructed by my direction by Mr. Barrow at last reached me in good and effective condition [142]. I then found it prudent to order Lieut. Waugh to join my headquarters [315].
>
> Lieut. Waugh joined me at Saini station on the 3rd January; he has made himself eminently useful and fully equalled the high expectation which I had formed of him.
>
> The season has been most unfavourable. Previous to my arrival at Begaruzpur on the 11th December, there were occasionally both days and nights which admitted of good and steady observation, but from that date onwards to 4th February the lower strata of the atmosphere seemed to be chocked with an accumulation of smoke and vapour so dense as to limit the view to a very few miles[6].

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[1] Report, 30–8–36 (2–4). [2] modern value 7433. [3] road cut under supervision of Kallonas; still exists 1951. [4] Both in good condition in 1950. [5] Narr. 1834–5 (37–47). [6] Report (1836) (4–8); cf. *GTS Syn.* II (ix) & *Meridional Arc* (xxvi–vii).

Observations were carried steadily south, Everest and Waugh working on either flank until 1st May 1836, when the hot dusty weather brought work to a close on the line Juktipara to Pagaro, just south of the Chambal[1] [27 : pl. 4].

Spending the rains of 1836 in Mussoorie, Everest started out again on 1st October, accompanied by Waugh and Jones, and his civil assistants. He erected an observatory and observed an azimuth at Kaliāna, the station he had established near Muzaffarnagar as the northern end of his astronomical arc [98], and

> on the 10th October I continued...to the southward, and reached Dholpur by the 2nd November. ... Lieutenant Waugh was to proceed...with one party to the stations of Juktipura and Pagaro, ... and thence proceed southward with the triangulation, whilst I with the other party advanced along the high road through Gwalior until I reached Kolaras, which is midway between the Chambal and Sironj[2], and thence commenced the...remaining portion. ...
>
> Three of the eight stations...selected for verificatory azimuths are situated in this line, ... but...this was not likely to cause much delay [96]. The whole work, triangulation included, was not...to occupy the entire season. ... As soon as the connection with the base-line at Sironj had been effected, others of the eight...azimuths should be observed, ... and...the vertical angles at the stations of the Doab...should be carried into effect[3].

There was an unfortunate delay at Dholpur, where the surveyors were to cross the Chambal into Gwalior State. Everest had asked that representatives of the State should meet him, to accompany the several detachments through State territory, and ensure protection and regular supplies and labour. He was the more particular because of Rossenrode's difficulties three years before. As no officials were there to meet him, he protested to the Resident in a series of imperious and tactless letters, and obstinately refused to move forward. He and Waugh were thus delayed more than two weeks before work could proceed [155-6].

Amongst Waugh's later letters is one from Dhobai station :

> Shergarh came out very well after clearing the ray on Ladara [about 2 miles N. of Shergarh], and rolling great stones out of the way. The station has not been raised higher than 8 feet, and the centre pillar is...very strongly built. ... The depression of Shergarh was taken last night during gusty weather, and the lamp very faint, and they are as wild as might be expected under such circumstances. I have, however, written to Mr. James to observe simultaneously this evening, and then the depression now sent will not be required.
>
> We march to Kansri...tomorrow ... No cold weather yet. I trust the lateness of it's appearance augurs...a cold spring. I expected to have been frozen in the observatory long before this, whereas it is very comfortable...even with summer clothes. We have had many sick cases in hospital, but since I have ordered them all up hill where the air is always mild and pure, they have all got well, but poor Aloo, who has been greatly broken down by fever.
>
> I hope to procure...a fine bear's skin hearthrug to ornament the Park. ... The tiger or lion continues troublesome at Den, and the khalasis and sepoys are very much afraid of it[4].

Having closed his triangles at Sironj where he met Jacob from Bombay [73], Everest returned to Aring, to meet Waugh who had been revising the observations of the previous season to rectify a discrepancy found during computation.

> Part of this discrepancy had doubtless arisen from over-anxiety to complete the observations with expedition ; ... but partly it was attributable to my having omitted the precaution... of isolating the central portion of the platform on which the instrument stood with respect to that portion on which the observers tread. ...
>
> At Aring the station had been fixed on the roof an old castellated building, erected by a tribe called Gujars [II, 37-8]. There were three stories to this buiding, the roof of each being vaulted, and...I had first bored a cylindrical aperture 6 inches in diameter perpendicularly through each roof to the ground floor, where a markstone was sunk[5]. I had raised on the upper roof a hollow cylinder of masonry, surmounted by a circular slab of 4 feet diameter for the instrument to stand on and, that this might be isolated, I had the rafters which supported the observer's stage placed so as to rest on the walls of the edifice[6].
>
> This was...the usual form of construction adapted in all the towers in the Doab, where it had been found to answer, ... but in the case of Aring, some unsteadiness had arisen from the badness of the old masonry and, that this might be remedied, I requested Lieut. Waugh...

---

[1] DDn. 342 (18-9), June 1837.

[2] near Gugubera HS. [pl. 4].

[3] DDn. 344 (91-104), 3-8-39.

[4] DDn. 378 (317-9), 20-12-36.

[5] cf. station at Pir Ghaib [34].

[6] cf. DDn. 287 (254-5), 29-12-33.

> to...commence the construction of a pillar which, passing through all the vaulted roofs, should isolate the instrument. ...
>
> I arrived at Aring on the 11th March 1837, and there found Lieut. Waugh...carrying my instructions into effect. ... As there was now no overt semblance of unsteadiness, ... the set of angles was as accurate as could be desired, and this difficult station...was overcome in the short space of 2 days. My presence being now urgently required at Kaliana to examine the astronomical circles, and put...the astronomical branch of the department into proper working condition, I left Aring on the morning of the 16th March[1].

Whilst Everest now attended to astronomical work at Kaliāna [98], Waugh took charge of the vertical angles across the *doāb*. He formed four parties, each provided with an "18-inch altitude and azimuth instrument with vertical circle read by two micrometers", and each observer made simultaneous observations with three other stations[2].

> Progress...was at first greatly impeded by bad weather, but as the season advanced the atmosphere improved to an extent quite unusual at that period, ... and in the month of May was clearer than it had ever been known since my first arrival in the Upper Provinces. ... All the observations...were completed by the 7th June, two days after which the whole party... assembled at my headquarters.
>
> The marvels...of refraction which were experienced by Captain Waugh...were of a similar kind to those of which I have before spoken [III, 235 ; IV, 105–7], but of a still more astounding extent. ... Instances [included]...two stations 20 miles and upwards asunder, the observed vertical angle and its reciprocal were both elevations at the same instant[3].

Completing his computations at Mussoorie, Everest reported that the closing of the triangulation showed a discrepancy of 3½ feet between the two base-lines, that would entail a remeasurement of the Sironj base the following season [16, 53].

Beyond these so-called "terrestial operations", he was now faced with the essential astronomical observations required at the terminal stations [99–101]. He had constructed an observatory at Kaliāna, some sixty miles south of Dehra, and had spent two months there on his return from Sironj setting up the two circles that had not been tested since their arrival in the country five years ago.

He was greatly distressed to find that they would have to be reconstructed before they could give reliable results. He obtained permission to call Barrow up from Calcutta to carry out the work at Kaliāna, but this took longer than expected, and the circles were not ready for service for another two years [131–5].

Season 1837–8 was devoted to the remeasurement of the Sironj base and the reconstruction of the astronomical circles. On the clearing of the rains, Everest took observations for azimuth at Banog, and the whole establishment set out from Dehra on the 1st October. Whilst Waugh moved on from Kaliāna on 8th October, Everest remained there another ten days to start Barrow on the circles, and overtook Waugh at Muttra on 22nd. He reached Sironj on 17th November, but was so saturated with fever that he had to leave the base-line to Waugh, who completed it by 18th January 1838[4] [53–4].

On the return journey to Kaliāna Logan was deputed to revise doubtful angles at two of the stations, this being the "finishing stroke...to the terrestial operations of the section of the Great Arc between Sironj and the Himalaya Mountains"[5].

REVISION, SIRONJ TO BĪDAR, 1838–9

Whilst at Sironj in January 1838 Everest determined to re-observe the whole triangulation southward to Bīdar, which included the work of Lambton's assistants 1817–22, and his own work 1823–5. This would ensure that the six degrees of arc south of Sironj would be of the same high quality as the similar length that had just been completed to the north. The remeasurement of the Bīdar base would follow as a matter of course [17, 55].

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[1] Report, 3–8–39 (45–52).
[2] Waugh, Jones, Logan, W. N. James.
[3] *Meridional Arc* (xxxii–iii).
[4] *GTS. Syn.* VIII (viii, A).
[5] Report, 3–8–39 (124) ; season 1865–6, series north of Delhi was strengthened by new stations and triangles : *GTS. Report*, 1865–6 (xxxvi, 21) ; *GTS.* IV (xi–A) ; pl. 5.

To give effect to this plan Waugh was to start at once on the long journey to the south, that he might make the necessary preparations at Bīdar, and start working northwards in the following October. He and Everest left Sironj on 19th January, and 40 miles to the north on 26th January Everest wrote out his instructions to Waugh and his request for Government approval [16–7]. He notes elsewhere the enormous distances covered by this marching and countermarching ;

> From Shadaora[1], where Captain Waugh quitted my camp, to Hyderabad—at which latter place he was to take up his quarters until the suitable period arrived for commencing operations—is a journey of upwards of 650 miles. ... The triangulation had been extended by me in 1836–7 as far south as the line Kamkhora to Bhaorasa, between which and the line Damargida to Malgi there is a meridional distance of 426 miles which had to be triangulated...between the opening of the season 1838–9 in October and its close in April, after which both his party and that destined to meet him were to proceed...to Dehra Dun, a further journey of nearly 500 miles, whence it will be seen that between the end of January 1838 and the beginning of June 1839, Captain Waugh had to travel...nearly 2,000 miles[2].

On his way south to Hyderābād, Waugh was held up by a sharp attack of fever but he fortunately recovered in time

> to...observe azimuths at Damargida...between 8th and 9th October. This...achieved, he proceeded with the triangulation in a northerly direction, and by dint of great perseverance and energy reached the station of Dhar [20 miles north of Ellichpur] on the 27th March 1839[3].

His pre-occupation with the astronomical circles prevented Everest himself from re-observing his old work south of Sironj and he sent Renny instead. Renny left Dehra on 9th October 1838, and reached Sironj on 24th November. He had orders to keep all the old stations that could be found, but to add the diagonals of quadrilaterals and one or two new stations.

> Captain Renny reached...Gargaja where his first observations were to be made on the 28th November, and met...Captain Waugh in the neighbourhood of Dhar...on the 27th March, ... by which date not only all the revision of the triangulation was completed, but full sets of intermediate azimuths had been observed [96]. ... Both parties proceeded northward to rejoin my headquarters at Dehra, where they arrived...on the 2nd June [1839]. ...
>
> The success...was...fully to equal the expectations, ... for now, instead of the portion of the old work between Beder and Seronj being...a blot on the general accuracy of the Great Arc of India, it may be looked on as quite in keeping with that to the northward.
>
> South of the line Pilkher to Ikjhera...there were...abundant instances in which errors of 3, 4, 5, 6, seconds were detected, whilst there were more than one...of 10 to 12 seconds. In the work...executed by myself in 1824–5 there were also detected here and there errors to the amount of 2 to 3 seconds, and in one case so much as 5″. ... The discrepancy between the computed and measured lengths of the old Beder base of 1815 of 6 feet 7 inches...arose from an accumulation of errors...in the triangles [16]. ...
>
> The completion of this revision brought to the desired conclusion all the terrestial operation between Damargida in latitude 18° 3′ and Banog in the Sub-Himalaya mountains in 30° 29′, all but the measurement of a base-line in the valley of the Manjra [near Bīdar], and its connection with the triangulation.

For geodetic purposes this measurement was divided into two sections—Damargida to Kaliānpur—Kaliānpur to Kaliāna, thereby avoiding any re-measurements at Tākarkhera [5].

> Though Banog, the extreme northern point, ... is...in latitude 30° 29′, yet as the locality of that mountain renders it very unfit for a limiting station of a section, it has been used only as a principal station for topographical purposes, and for connecting the Dehra Dun base with the triangulation.
>
> In fact, it has not been deemed prudent to approach too near to the mighty mountain masses of the Himalaya range, and...I preferred to shorten the northern section by selecting Kaliana as the station for observing amplitudes, although it lies 60 miles more southerly than Banog, and 57 miles to the south even of the base measured in the Dehra Dun[4].

---

[1] near Deadheri hs. [pl. 4].

[2] *Meridional Arc* (xxxviii).

[3] ib. (xxxix).

[4] ib. (xl); cf. DDn. 344 (18–26), 25-2-39, paras 11–17 ; Everest's value for northerly deflection at Banog came to 20″, the modern value being 32″·7 [104–5]; *GTS. Trig. 53 J* (10).

> Kaliana is, astronomically speaking, the northern limit of the section between Sironj and the Himalayan mountains. ... Kalianpur is...the southern limit of the same section, and also the northern limit of the section between Bedar and Sironj, and...Damargida is the station in the vicinity which as been fixed as the southern limit of this latter section.
>
> Thus...the two sections meet at Kalianpur...nearly halfway between Kaliana and Damargida. ... The station of Takal Khera...has been abandoned for several reasons. ... The superiority of the instruments at my command has rendered it a needless expence of time and money to measure a base at that site, especially seeing that it is not peculiarly important in regard to locality, and that there was always reason to doubt its fitness...because of the high range which bounds the valley of Ellichpur to the north and...unquestionably...[exerts] a lateral attraction on the plumb-line and level[1].

Conclusion, 1839–42

During the next two seasons, 1839 to 1841, whilst Everest was engaged on astronomical observations at Kaliāna and Kaliānpur [99–101], he employed his assistants to run minor triangles from one principal station to another by the system of ray-tracing. By this means he filled in the charts of the Great Arc with important topographical detail of a high order of accuracy [79–81]. On his return from Kaliānpur in 1841 he travelled through Agra to hand over

> to the Commissary of Ordnance...such of the larger class of instruments as were not again likely to be required...during my career in India, and...I determined to march through Bharatpur, ... Alwar, ... and Gurgaon, to Delhi ; thence to Kaliana...and so back to Dehra. My object in taking this route was mainly to lay down the...ranges of hills on which my stations of Chapra, Pat, Meoli, are fixed, and...these are all on the ray-tracing principle, but carried on by perambulator instead of minor triangles [32, 70 ; pl. 4][2].

During 1842 and 1843 he was fully occupied with correspondence and with the computations, reports, and charts, of the Great Arc, the final field operations of which were brought to a close by the measurement of the new base-line near Bīdar and its connection to the triangulation [17]. In making good the connection with the old work, Waugh established four new stations to the south, to replace earlier ones whose markstones could not be found.

In his final report of August 1842, Everest reports that the principal meridian had been traced as far as Kedar Kanta and Jharsu[3] in the Himālaya.

> The positions of 109 principal stations and of 1720 secondary points have been finally determined. ... The length of two contiguous arcs of the meridian, the one 6° 3′ 55″·973, the other 5° 23′ 37″·058 in length, have been measured. ...
>
> The work...was taken in hand in February 1833, and the conclusion may...be considered as the 9th January 1842, as the southern section is in reality a revision of work executed in 1824–5 and prior thereto by myself and others. It is proper to add to the period...that occupied with the original operations, which may be estimated at nearly two entire years, and the whole period taken up from first to last will then amount to about 11 years. ...
>
> The means placed at my disposal...have been most liberal and ample. ... The result has ended in entire success[4].

The conclusion of this great work was acknowledged in the following resolution by the President in Council ;

> The Government of India has derived credit from the manner in which Colonel Lambton conducted the early proceedings of this measurement, and brought up the meridional series from the southern extremity of the peninsula to Bedur in the Nizam's Dominions. ...
>
> Lieutenant-Colonel Everest...submits the result of the same series carried up from Bedur to Seronj, and from Seronj to the foot of the Himalaya, with the deductions from celestial observations made simultaneously at the three points. The pains taken in every part of these laborious operations, no less than the superiority of the instruments and means at the officer's disposal, warrant the conclusion that this part of the arc measurement bears out the character gained for the work by his predecessor, and even excels it in the nicety of the observations... and in the tested accuracy of the results. ...

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[1] Report, 3–8–39 (8). [2] Report, 1842 (113–20). [3] latitudes 31° 1′ and 31° 20′. [4] Report, 1842 (159–61) TS. 7/2, Secondary trgn. Gt Arc.

> Colonel Everest, when he returned from Europe in 1830 pledged to the Hon'ble the Court of Directors to complete this work, contemplated only carrying up the Arc measurement from Seronj to the Himalaya; to this, however, he has added a revision of the triangulations between Seronj and Bedur. ... He has lastly added a remeasurement of the Bedur base. ...
>
> These works of revision and verification...placed beyond the possibility of doubt the general and particular accuracy of the entire work, and give a value to the practical as well as to the scientific results that will be recognized in all countries where science is cultivated.
>
> It remains...to offer...thanks...to those by whose services the work has been thus accomplished. The name of Colonel Everest will be associated with his part of the work, as that of Colonel Lambton has been with the preceding operations.
>
> Lieutenant Waugh and Renny...have...established claims to high commendation, and have proved themselves to be possessed of scientific attainments of a high order, as well as activity, energy, and unwearied powers of application and resources. ...
>
> The Assistants and Sub-Assistants named by Colonel Everest, viz., Messrs James, Clarkson, Olliver, and Baboo Radhanath, deserve to be mentioned with a similar commendation[1].

For later appreciations of Everest's work, see papers by Archdeacon Pratt and Captain Tennant, *Philosophical Transactions of the Royal Society*, 1855, page 78; papers read before the Royal Astronomical Society in January and June 1857, and the *Journal of the Asiatic Society of Bengal*, vol. xxviii, page 20. Everest's own account is contained in his MS. Report, TS. 7 [111], and in his *Account of the Measurement of Two Sections of the Meridional Arc of India*, published in 1847 with a separate volume of engravings[2] [113].

Technical results are described in chapters VII to X of this volume.

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[1] DDn. 401 (203-8), 14-10-42.

[2] Reviewed, *JRGS.*, xviii, 1848 (liii).

CHAPTER IV

BASE-LINES

Colby Compensation Bars — Standard Rods — BASE-LINES ; *Calcutta, 1831–2 — Dehra Dūn, 1834–5 — Sironj, 1837–8 — Bidar, 1841 — Bombay Survey.*

ALL Lambton's base-lines had been measured by an elaborate steel chain similar to that used by General Roy on the Ordnance Survey of Great Britain.

The chief objection to measurement by rod or chain is the variation of length caused by change of temperature, which is difficult to ascertain at the exact moment of measurement. Chains are further liable to intermittent lengthening caused by repeated and unequal tension, and by the wearing of joints from friction and rust[1] [II, 257 n.5 ; III, 250].

To eliminate, or reduce to a minimum, the uncertainty of temperature, Colonel Colby of the Ordnance Survey devised for the survey of Ireland what he called a compensation bar, which should theoretically have the same length at all temperatures. It consists of two ten-foot bars, one of brass, the other of iron, firmly fastened at their centres, but otherwise free. At each end was a short transverse link, or tongue, so attached to each component bar that as these changed in length with the temperature the short link slewed in position. Each link carried a dot so placed that the distance between the dots should maintain a constant length[2].

The bars were supported on brass rollers and enclosed in a wooden case from which the linked ends projected. The full apparatus included six such component bars, each mounted on a pair of trestles. For adjustment and measurement there were seven microscopes each with a pair of eye-pieces about six inches apart, which distance was precisely measured by the microscopes and added to that of the compensation bars[3].

These bars had been first used in Ireland in 1827, and Everest "learned the use of them...when...trying those made for the E.I. Company on Lord's Cricket Ground, St. John's Wood Road". He made various small improvements in India later[4]. The measurement of a base-line near Calcutta was his first major task after his return and he took an early opportunity to set up the apparatus in working order.

> On Friday, March 11th 1831, the class of Natural History and Physics [of the Asiatic Society]...proceeded to the inspection of the new compensation bars. ... They were placed... with the various apparatus mounted to show the construction, the adjustments, etc. Captain Everest entered into a complete and highly interesting explanation[5].

The measurement follows a regular routine ;

> The apparatus is adapted to measure a length, at one time, of 63 feet, of which 60 feet is obtained from the six bars, 2·5 feet from the five microscopes connecting the bars, and ·5 foot from the half-lengths of the two end microscopes.
>
> The measurements being invariably horizontal, ... considerable care is taken to select a strip of ground which is either quite level or...generally undulating. ... The ground is roughly levelled...that trestles of various heights...may be prepared for supporting the bars. ... The alignment is marked out...by...a "boning instrument"...put up near the rear end...and... moved forward...after each length, or every alternate length, is measured. ...
>
> The operations are invariably conducted under tents, in order that the apparatus may be sheltered from wind and...from the direct rays of the sun. Two sets of tents are provided,

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[1] Fredk. Thos. Colby (1784–1852) ; RE. 1801 ; OS. 1802 ; DOS. 1820 ; OS. Ireland, 1825–47, *DNB.* ; *RAS mn.*, XIII (95–109). [2] Everest (54) ; Markham (84–5) ; Gore (146–7). [3] Detailed descriptions ; *GTS.* I (47–52) ; *Meridional Arc* (lxxxiii) ; pl. E (15–9) ; Lancaster-Jones (24–5). [4] Everest (35) ; *GTS.* I (48). [5] *Gleanings in Science*, III (93) ; cf. *As R.* XVII ; ii, 1833.

> that one set may always be ready in advance. ... A small tent is also provided for the boning instrument. Eight officers are required, ... one at the boning instrument and one at each of the seven microscopes. An assistant is employed in advance in laying the trestles.
>
> The first stage...is the laying of the trestles...with...a small theodolite. This done, the camels are placed on the trestles, the bars on the camels, and the microscopes on tribrachs which are attached to the ends of the bars. ... The first, or rear, bar carries a microscope at each end, the other bars carry one at the forward end only.
>
> The first bar of a set having been levelled, the microscopes at its extremities are levelled, and each is adjusted on the compensation point on the contiguous tongue of the bar. The rear end microscope is centred...on the register head which marks the termination of...the preceding set of bars. ... The second bar is adjusted to the height of the first and aligned. ... By similar process the whole of the bars are brought successively into the line.
>
> The measurement of the length is the last part of the process. It is completed when the... rear end microscope is centred...on the register below, and when the compensation points of all the bars are exactly bisected by the central wires of their microscopes. A register is then centred...at the forward end of the bars, in order to mark the termination of...this set. ...
>
> The registers are of three descriptions, viz., solid equilateral slabs of cast-iron —... cast-iron triangular frames, carrying a brass sliding tube that can be raised or lowered at pleasure ... and stout wrought iron pins, from 18 inches to 4 feet long, which are used whenever the measurement is likely to be suspended. ...
>
> The heads of the two first...contain a single point of reference...to which motion can be communicated by slow-motion screws. The heads of the pin registers are larger and contain several points, in rows, each point having a number engraved beside it, ... an arrangement necessitated by the difficulty of driving the pins accurately into the ground[1].

STANDARD BARS

The exact length of his measuring rod or chain is not of great concern to the land or topographical surveyor engaged on areas of small extent. True, Mackenzie took pains to obtain a near agreement between the measures of his various surveyors, and, for the measurement of the central base at Ballapur, the length of the chain was carefully compared against that of "Mr. Mather's black wood ruler of 4 feet" [ii, 205].

The revenue surveyors were seriously exercised to find a standard unit that could be accepted for the whole area of survey, rather than trust to local units that varied from district to district [iii, 163–4]. But the average surveyor was content to accept as correct whatever chain or scale he happened to purchase or obtain from government store.

In the case of a national or a geodetic survey, however, it is essential that there shall be a recognized standard of length for the accepted unit of measure. If the unit be one yard, any error in that unit would be multiplied two and a half million times in the distance between Cape Comorin and the Himālaya.

The chain that Lambton obtained from Dinwiddie was "set off from Ramsden's bar at 62° of Fahrenheit". The chain which came out in 1802, and used for comparison only, had been "set off at the temperature of 50°". Finding that the relative lengths of these two chains varied continually, Lambton twice checked the second one against his three-foot brass scale that had been "laid off by Cary from the scale of Alexander Aubert" [ii, 254, 257][2].

> For many years the only standard used by Colonel Lambton was a standard chain. ... In the course of the operations the joints of this standard had become oxidated, and...in cleaning them the length became altered, subsequent whereto it could no longer be relied on as an invariable standard [ii, 257 n.5]. ...
>
> After the disaster...Colonel Lambton struck out a method of comparing the chain with our three-feet standard scale of brass by Cary, but the experiments were always very wild, ... though in 1824–5 I followed precisely in the steps of my predecessor [iii, 249]. ... I have taken the only feasible mode of applying a remedy, by remeasuring the Sironj base with the compensation bars, and intend to treat the Beder base in a like manner[3] [16–7].

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[1] *GTS.* I (48–51) ; cf. *Meridional Arc* (lxxvi–xciii). [2] Geo Everest (50–1, 53). [3] Everest (132–4).

In 1821 Lambton had adjusted all his work to Kater's revised value for Cary's brass scale [II, 262], but there had been so much uncertainty in the application of that scale to Lambton's base-lines, that this adjustment was of little real value[1].

Everest therefore arranged for the construction by Troughton and Simms of two ten-foot standard bars and two six-inch brass scales. After being officially compared and certified, the bar and scale marked A accompanied him to India in 1830, whilst those marked B followed three years later[2].

Bar A was compared against the compensation bars at all base-line measurements, and also during 1832 against all the old chains and scales, including the chain that Shortrede had used on the base-line at Karli [III, 131 : IV. 56].

> From the middle of May to the 8th November [1832], a series of experiments was carried on daily in the grounds attached to my office in Chowringhee for comparing the standard bar. ... The delicacy of these comparisons can only be appreciated by those who have witnessed them[3].
>
> The comparisons were made...as follows. Eleven isolated pillars of masonry are raised as nearly as possible at...ten feet asunder, upon each of which a microscope is placed, the last... being furnished with a micrometer wire. ... A boning telescope placed in the rear serves to place all the microscopes in alignment. ...
>
> The standard bar, furnished with a level, is placed underneath Nos. 1 and 2, which had been previously levelled and adjusted laterally. No. 2 is then raised or lowered until it is in focal distance, so that when one of the dots of the bar is...intersected by No. 1, the other could be... intersected by No. 2. Thus the whole series of bars is set off in succession. ...
>
> The bar is furnished with two thermometers whose bulbs are let into the body of the metal, and these are noted at the time of deciding on the position of each microscope, so that the distance between the first and eleventh microscope is the length of ten bars at the mean of all these temperatures. ...
>
> These comparisons are not yet definitive, for there are two iron Standard Bars belonging to the Great Trigonometrical Survey, A & B, of which A only is with me, and B has been left in England, in order that it may be compared with the Tower Standard, which want of time prevented my accomplishing. The standard B may be expected to arrive sooner or later when it can be compared with my standard A, otherwise the standard A must be sent to England when I next return, pending which the relation between our measurements and the Parliamentary Standard will remain more or less uncertain[4].

In advising the despatch of the standards B, the Directors explained that they

> were retained in England for the purpose of being compared with the standards of the Board of Ordnance made use of in the survey of Ireland. The comparisons have been made with the bars kept in the Tower of London, but the latter still have to be compared with those in Dublin[5].

These second standards, 10-foot and 6-inch, reached the Surveyor General's office in Calcutta during February 1833, and were compared against standards A at Dehra Dūn during 1834 and 1835. The compensation bars had to be compared against the standard bars

> under precisely similar circumstances to those which obtain during the measurement. In the comparisons at the Calcutta base, which was the one first measured in India with this apparatus, ... the comparisons were made, not in the base-line tents, but in buildings attached to the Surveyor General's offices...during the night. But the comparisons after the two measurements of the Dehra Doon base, and on all subsequent occasions, were made in the base-line tents under circumstances very similar to those of the measurement—that is to say—they were commenced early in the morning, suspended for a short time and resumed before noon, and concluded in the evening. ... They have invariably been made for at least three...days before and after each measurement[6] [51, 53].

The two standards B, 10-foot and 6-inch, and one standard thermometer, were returned to England in January 1844, and deposited at the Ordnance Survey office at Southampton for comparison with the national standards in England[7] which had not been completed before. Standards A were retained in India. In 1866, new standards were obtained, and compared first against B at Southampton, and then against A at Dehra Dūn[1].

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[1] GBO. Comp. A-3/18 (G-11/18), notebook with obsns. and bar comparisons, 1831–2. [2] Everest (136); brass scale A now in Survey Museum, Dehra Dūn. [3] DDn. 286 (85); 10-10-33; cf. *JASB.* II, 1833 (130-43). [4] DDn. 323 (35–46), 15-9-32; to Shortrede. [5] CD to B., Mil., 1-8-32 (1-3). [6] *GTS.* I (52); summary of comparisons TS. 7 (2), (143–5); DDn. 452 (59-60), 30-12-43. [7] *Meridional Arc* (lxxv); DDn. 452 (67-8), 6-1-44; 510 (98), Renny to SG., 8-4-44.

CALCUTTA BASE-LINE, 1831–2

The measurement of a base-line was essential to the closing of the longitudinal chain of triangles which Olliver had brought some 600 miles from the Great Arc near Sironj[2]. Less than six weeks after his return Everest asked permission to search for a suitable site, which should be on level, firm, ground, preferably between two of the telegraph towers on the right bank of the Hooghly [III, 263–4 ; IV, 81], failing which it would be necessary to build two special towers for the purpose[3].

After a week's reconnaissance he reported that he had found a suitable line between the towers of Paintal and Dilakas, 16 and 24 miles north-west of Calcutta. Two or three hundred trees would have to be felled, and some mud huts cleared ; "an immense number" of small tanks would have to be filled up, as well as the comparatively dry beds of two small channels. He left the young engineer subaltern James Western, with an assistant surveyor[4], to survey a passage about 18 feet wide[5]. After discussing the probable cost of clearing this of all obstacles, he accepted the Executive Officer's proposal to take a line along the Barrackpore road on the left bank of the river, and erect two special towers.

> To prevent the interference of wheeled carriage the old roads may be repaired and used during...your measurement. ... As there are 10 or 11 miles in a direct line, it is probable... that you will be able to obtain the distance you require without being obliged to have trees cut down, entering the cultivation, or otherwise injuring property. ... It would be attended with less inconvenience to the public.
>
> If you could find distance enough commencing at the Governor General's stables, and running towards Barrackpore, ... only one bye-road would be requisite, but much more inconvenience would be avoided if...carriages might be permitted to pass *at a slow walk* for 100 yards on each side of the spot under immediate measurement.
>
> There are many points connected with having a line on this road to make it desirable. First, the expense may not exceed...2,500 Rs. ; next, certainty of time at which you may commence, and...convenience of distance to your own office[6].

Everest made a number of stipulations ;

> Enclosed is a rough sketch...of the road and Great Trigonometrical stations. The southern point must be as near the bend of the Chitpore road as possible. I purpose letting the line cross the neck of the bend, and having the tower built off the road on the east side, where there is a sort of natural ground near the house of one Baboo Hurrie Parsad Khuttie.
>
> The road seems very straight, but between the 8th and 9th milestones a faqueer's hut and a large banyan tree encroach on the kutcha part which I purpose using. ... Considering the total breadth divided into two side parts of 19 feet each, and a centre part of 26, I purpose confining the measurement to the western of the former strips.
>
> The northern term may be about the 11th mile-stone ; the base will then connect with the telegraph tower at Nebreea, which is one of my stations. The southern end will also connect with my Observatory which terminates the series [III, 186–8]. The heights of the towers must be sufficient to overtop all such intervening obstacles as cannot be removed.
>
> It is reported...that carriages affect the level sensibly, moreover that the dust renders it impossible to see, ... but...I shall not object to the road being kept open provided the following points can be rigidly enforced.
>
> That 150 feet to the north and south...of the part of the line actually occupied by the apparatus, carriages and passengers of all kinds must go at a slow walk. ... The dust will incommode me extremely, and loose cattle, sheep, or pigs, or dogs, or led horses, must on no account be permitted to travel at all by the road between the 5th and 11th mile-stones. Further, as it is indispensably necessary that the line of vision should be quite uninterrupted from one end of the base-line to the other, carriages, and passengers of all kinds whether mounted or on foot, should be strictly restrained beyond the middle of the road[7].

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[1] Markham (143). [2] *GTS Syn.* xii (99). [3] DDn. 265 (85–8), 17–11–30. [4] W. N. James. [5] Map by Western, Jan. 1831 ; MRIO. 49 (1–4). [6] from Ex. Offr., Chinsurah, 15–3–31 ; DDn. 264 (172–5). [7] DDn. 266 (73–5), 19–3–31.

He was impatient at the long time it took to get Government sanction :

> The period is now arrived when I ought to...hire and instruct the people who must be taught beforehand, or we shall have some incalculable blunders and mischief to lament. ...
>
> Tents...to protect the new apparatus from the direct...rays of the sun...should be commenced upon without delay, for operations of this nature should never be hurried or hard pressed for time. It is one of the earliest maxims which was inculcated in me by the late Lieut. Colonel Lambton, ... which all my experience goes to verify, that hurrying and harrassing oneself and one's subordinates only causes delay and confusion, and by taking such matters leisurely and quietly by far the greatest and most steady progress is attained[1].

Sanction was issued early in August, and orders passed for construction of the tents. The establishment authorised included the loan of Sergeant Murphy as 'picket sergeant'', but not the party of 30 British gunners and n.c.o.'s that Everest had asked for. Government further hoped that the road would be restored "to the use of the public within as short a period as may be consistent with the attainment of the object in view", and "that no necessity...is likely to occur...for destroying or injuring any of the trees which now adorn that road, and afford shade to the travellers[2]". Orders for the construction of two towers, about 75 feet high, at a total cost of "sicca Rs. 5,763" were passed on 2nd September[3] [81–2].

Western was placed in charge of the working party, with Murphy and Logan to assist him. Wilcox, Olliver, De Penning, and Taylor—the recently appointed astronomer at Madras Observatory—all assisted in the measurement.

As a precaution against any sinking of the towers, a large stone was embedded about 66 feet from each tower, at the end of a set of compensation bars.

> Both stones were subsequently vaulted over so as to admit of future reference. ... A stone was also embedded at the end of the 12th set of bars, with the view of trying the same length by remeasurement after the whole work was finished.
>
> The bars were compared with the standard A 67 times before the measurement, and 80 times after. ... The comparisons...were made in a thatched building erected in the grounds attached to the Surveyor General's office, Chaoringhi, and at night by lamp light, one of the reverberatory lamps with an Argand's burner being placed at as great a distance as admitted of its properly illuminating the microscopes, but this plan is liable to the objection that the comparisons were made under different circumstances from those under which the measurement was conducted [47]. ... The comparison of the microscopes was made on seven different occasions during the measurement, including those prior and subsequent[4].

The following are orders that Everest gave Western for the first series of comparisons, which were to be "commenced at 7 o'clock in the afternoon of Monday the 8th [November] and be continued until the morning at 5 o'clock".

> The standard bar is first placed under the two fixed microscopes, and its length noted, as well as the...two thermometers and the time. It is then moved out of the shed, and the [compensation] bar A is brought from the tent to replace it. ... The other bars are brought forward in like manner in succession, terminating with H, which completes one set of comparisons. The first set being completed, a second, third, etc., are gone through consecutively, the state of the thermometers belonging to the standard being only noted when that bar is under the microscopes.
>
> The light is thrown by means of two reverberatory lamps, placed so far off as not to communicate a sensible degree of heat. Great care must be taken to prevent anything striking or touching the fixed microscopes except at the graduated heads, which must be moved round most gently. The standard bar must never be touched by any person's hand.
>
> I divide the gentlemen and others...into four parties, two of which will operate the first night, and two the 2nd., taking duty alternately through the week. The first night, the first and third parties will be engaged ; the former beginning at 7 o'clock and continuing till 12, when it will be relieved by the latter. On the 2nd. night, the 2nd and 4th parties will relieve each other in the same way. ...
>
> 1st. party, Captain Everest—Mr. Olliver—Sergeant Murphy.
> 2nd. party, T. G. Taylor, Esq.—Mr. Logan—Mr. Torrick.
> 3rd. party, Lieut. Wilcox—Lieut. Bridgman—Mr. Peyton.
> 4th. party, Lieut. Western—Mr. Rossenrode—Gunner Doyle.
>
> You will be pleased to tell off the natives into 4 parties, consulting Mr. Olliver[5].

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[1] DDn. 265 (219–22), 1–7–31. [2] DDn. 263 (300–2), 12–8–31. [3] later raised to Rs. 7,168–3–6

[4] *GTS.* I (1–3). [5] DDn. 267 (83–4), 7–11–31.

The base-line lay between the 4th and 11th milestones, and measured 6·43 miles, and the two towers are still in good condition 120 years later[1]. Measurement began from the south tower on 23rd November, writes James Prinsep, and

> ended on the 21st January 1832, an interval of 58 days, of which 13 may be set down as holidays, so that the actual time employed was about 45 days. The length of the ground measured upon an average was 750 feet a day, or 12 sets of bars, but towards the conclusion, so systematic had become the arrangements that 18, 20, and once 24 sets (that is 1,512 feet) were measured in one day, which is double what was effected on the Irish survey. This was chiefly attributable to the number and experience of the officers employed. ...
>
> At the boning telescope...Lieut. Western with Lieut. Bridgman — ...First microscope... Mr. T. Taylor — ...Central microscopes...Mr. Logan, Mr. J. Olliver, Mr. J. Peyton, Mr. M. Torrick and Mr. W. Rossenrode — Last microscope...Lieut. R. Wilcox. ...
>
> At the north tower it was found beforehand that there would be about 3 feet to spare in excess of a certain number of bars. This, added to the possibility of the dot on the centre stone moving during the settling of the towers, induced Captain Everost to adopt the expedient of sinking a heavy stone of 3¾ feet cube into the ground at the distance of one set of bars south of it. Two brass plates were let into this stone to receive a dot at the exact distance of a set of bars from the tower, and one to receive the dot terminating the 538th set. By this arrangement the surplus interval could be measured at leisure with the same accuracy employed throughout the remainder of the line.
>
> The difference found on measuring eleven sets of bars was ·026, or 1/40th inch on 700 feet, a surprisingly small quantity, and only 1/3rd of what was experienced in the previous trial at Lord's cricket ground [45].
>
> The southern tower was found to have moved one-thirteenth of an inch to the S.E., which is not surprising considering the light nature of the soil, and the height, 80 feet, to which the building was...raised to place the theodolite within view of the other triangle stations[2].

A distinguished party witnessed the final day's work ;

> Through the politeness of Captain Everest...we enjoyed the advantage of an invitation to witness the remeasurement of the first day's work, with the view of ascertaining what might be the probable amount of error. ... The President of Physical Class of the Asiatic Society and many distinguished officers of the Engineer Department were present.
>
> An elegant breakfast was laid out in tents after the ceremonies of the morning were concluded. While contemplating with admiration the order and precision with which the whole process was conducted, we took an opportunity of sketching the apparatus as it stood[3].

A reduction of Prinsep's sketch is given on plate 2, taken from the frontispiece of Everest's *Account of the Measurement of two Sections of the Meridional Arc of India* [44, 113][4].

The connection of the base-line to the neighbouring tower stations was completed by June and brought the longitudinal series to a close[5]. The discrepancy of 7 feet 11 inches between the measured length of the base and that computed from the triangles indicated the disappointing quality of the latter [III, 264 ; IV, 6, 18–9].

DEHRA DŪN BASE, 1834–5

For the satisfactory closing of the Great Arc at its northern end, it was essential to measure a base of verification at the foot of the Himālaya mountains. Such base-line was to be from six to seven miles long, its site reasonably level and free from obstacles, and affording a clear view from both ends to suitable stations of the principal triangulation.

Everest first visited this area in April 1833 on his reconnaissance from Delhi, and on his march to Dehra looked anxiously for a favourable stretch of ground [25]. He found nothing suitable south of the Siwālik range ;

> The land immediately to the south...is intersected by frequent streams which have cut deep channels...replete with quicksands. ... Bordering on this range the sal forests are very dense, and...immediately these disappear they are succeeded by cultivation and dwellings. ...

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[1] DDn. 563 (18), 1–2–53, DSG. refused a suggestion that these towers should be dismantled. [2] Upper dot 73·35 feet above lower [94]. [3] by James Prinsep ; *JASB.* I, 1832 (71–2). [4] *v.* frpce. *JASB.* I, 1832, and pl. facing p. 309, *Roorkee Papers*, II (293–4) ; III, pl. xlvi. [5] GBO. Lib., Hj3., frpce. sketch to *Gt Arc Tables*.

> Between Meerut and Saharanpur rich fields of corn, thriving villages and towns, orchards and other plantations are abundant. ... Rivers, by overflowing their banks, ... seem to permeate a continued marsh. ... Ridges of accumulated sand, long and high, are so frequent as to render it well nigh impossible to trace a line of 7 or 8 miles...in any direction without encountering them. ... It would be impracticable, except in very advantageous circumstances, to see from one station...to another...without one or more artificial elevations[1].

He was better impressed by the ground north of the Siwāliks, more especially in the western Dūn, to the south of the river Āsan, which flows west to the Jumna. Accordingly, after spending the rains in Mussoorie, he started on 3rd November

> to explore the valley of Dehra Dūn. My first march was to Sisu Bara, where I encamped on the north side of the Asan, and on the evening of the same day, crossing the river, I commenced my examination on the south side. I had the good fortune...to pitch...exactly on the tract which proved in the end to be most favourable. ... There was an uninterrupted view for several miles, nearly free from trees. ... For the first transferring point the mountain of Banog was admirably adapted, and...a second...equally eligible was...the hill of Timli, or Amsot, on the Sewalic range [37 ; pl. 17].

Setting his assistants Kallonas and Clarkson [27] to clear jungle Everest himself explored to the west.

> I traced out a second base-line between Sahinspur and the Jumna. ... I visited the Amsot hill, returned to Sisu Bara to receive Mr. Kallonas's report, went over the whole course of the proposed line myself; took angles at Amsot and both ends of the proposed base, ... and then returned to Dehra, fully convinced that if the first selection was not exactly the best in the world yet it presented all the advantages I had been prepared to expect. ...
>
> This reconnaissance occupied 10 days. On the 12th November I was back at Dehra to receive and disburse the pay of my department, and as my journies generally amounted to 20 or 30 miles, and I was at work from morning till night, sometimes as late as midnight, ... there was no small share of fatigue incurred.
>
> The line between Sahinspur and the Jumna turned out a thorough failure. I left Mr. Peyton, my Deputy Computer, with 20 of my recruits, to explore the tract near Sisu Bara more minutely...and proceeded on my route. ... I examined the tract to the south of the Sewalic range, and found it so irregular and encumbered with jungle as to be hopeless.
>
> On the morning after my arrival at Saharanpur I proceeded to examine the country... which looked very favourable. ... I accordingly rode out...along a road winding through cornfields and other cultivation, and began to entertain hopes that this tract would perhaps be as favourable as the Dun; but after...2¾ to 3 miles I suddenly came upon the broad channel of the Hindan, and quitting the road, the more effectually to examine...its high banks and well filled stream, my horse suddenly came into a quicksand, from which I had some difficulty in extricating him. ...
>
> The Dun near Sisu Bara afforded...by far the best spot I was likely to meet with. ... There was no jungle; ... wood for tressels and pickets was abundant and to be had for the felling and cutting up, and there was...also—peculiar to waste tracts—an abundance of elbow room, without danger of interfering with the private rights of any individual[2].

Preparations for measurement along the southern bank of the Āsan were commenced a year later. The eastern end was

> about 1·2 miles nearly due west of Bhimtal, which is by the road from Dehra to the Mohan Pass. The line was measured over twice. On the 1st occasion...from west to east. ... The 2nd measurement was made in the contrary direction. ... The entire length...was divided into six parts and each part measured over twice.
>
> Fifty comparisons between the compensated bars and the standard A [47] were made before the 1st measurement in a thatched building...in the grounds of the Surveyor General's office, Dehra [167]. Sixty-one similar comparisons were made after the 1st measurement, and 66 after the 2nd measurement, at camp Barwala, under circumstances precisely the same with those under which the bars were used in practice, ... under the same tents, and at the same hours of the day [47]. ... The first set of bar comparisons was made on 12th November 1834, the last on 2nd April 1835[3].
>
> I had sent persons to Hurdwar in the preceding July to procure the necessary stones for the ends of the base-line, as also 3 pyramidical pillars 5 feet long for sustaining the microscopes, ... all of which I found in readiness for use on my return from my mountain excursion [38].

---

[1] Narr. 1833–4 (15). [2] ib. (25–34). [3] *GTS.* I (ii., 3) ; *Meridional Arc* (xxiv-1).

> As soon as the medical officers pronounced that the Dun could be entered without danger—for at certain seasons...it is a deadly tract—I sent a party under Mr. Olliver to clear away the high grass in the line...chosen in November 1833.
>
> I erected the stone pyramids at Dehra Dun on the 12th November, and commenced the series of comparisons...on the afternoon of that day. ... The series...was finished by the afternoon of the 15th November. ...
>
> On the 14th November I received a report from Mr. Olliver...that the river Asan had encroached so much to the southward that my line fell into its channel, in consequence of which I proceeded on the morning of the 17th to select a new position for the east end which, by throwing the whole length about 100 yards back, cleared the bank by about 50 yards. This rendered fruitless all the labour previously expended, and made a new clearance necessary, but it was taken in hand with vigor, and by the 1st December the operations commenced. ...
>
> The microscopes were under the charge of Lieut. Waugh, Lieut. Renny, Captain Wilcox, Mr. Olliver, Mr. Rossenrode, Mr. Logan, Mr. Peyton. Part of the time when Mr. Rossenrode was employed in superintending the construction of the end platforms and those on the summits of Amsot and Dhoiwala hills, Mr. Murphy, and...Sub-Assistants Kallonas, Radhanath, and Keelan, had each charge of a microscope. I took upon myself the management of the boning instrument...with which...the apparatus is aligned and directed.
>
> The whole base...is 39183·783 feet in length. These measurements are reduced on assumed height above the level of the sea derived from the data of Colonel Hodgson and Captain Herbert relative to Saharanpur [III, 38][1].
>
> I divided the line into 3 sections, and...when the whole measurement was at an end I selected 4 stations on the northern face of the Sewalic range, with which the two subdividing points and the two ends of the base formed a series of small triangles, my object...being to try one portion of the base against another by triangulation as well as actual measurement. The result is very satisfactory.
>
> The base-line was finished on the 5th February, after which comparisons were instituted... between the compensation bars and their standard[2].

Whilst measurement was in progress Everest had a visit from Godfrey Vigne [292], who had already met him on the Chour [38];

> I paid a visit to the Surveyor General in the Doon, where he was...measuring a base of verification, seven miles in length, the jungle being cleared for that distance, and the level being carried across numerous hollows by means of moveable wooden bridges. The manner in which everything was conducted appeared to me to be most admirable[3].

Everest insisted on carrying out the confirmatory triangulation himself, in spite of severe fever, leaving Waugh to make a second measurement ;

> The apparatus being of comparatively recent invention, there are...no data whereon to estimate its accuracy except those which rest on theory. ... The amount of error, however, is not very appalling—in the whole extent...1·6 inch, which is more than I had...expected—and confirms...that the degree of accuracy attained is not commensurate with the increase of complication in the machinery and the expence incurred. However, that is only my opinion.

This complaint of the tedious labour of measurement with the compensation bars did not prevent his appreciation of their vast superiority over the old chains [16–7].

On the conclusion of the minor triangles, Everest himself made the connection with the principal stations of the Great Arc [39][4].

At the time of the measurement the base-line lay in Government waste land, but Everest records that it was in 1837 allotted to "certain English gentlemen".

> The part in which my base-line and its two limits were situated became the property of Captain Kirke [168], who gave it the name of Arcadia, in commemoration of, and compliment to, the *Great Arc* series ! My station of Hatipaon, where my office stood, looks down on this lovely valley of Dehra, and it was really a beautiful and interesting sight to watch the cultivation growing as if by enchantment. When I left Hatipaon on the 1st October 1843, the whole was a rich and glowing mass of fields and orchards—fortunately my base-line had been already measured[5] !

Arcadia is a tea-garden to this day [168].

---

[1] 7·42 miles ; E. end 185·2 ft. higher than W.

[2] Narr. 1834–5 (2–13) ; base-line compns. TS/II (141–60).

[3] Vigne, I (39–40).

[4] Narr. 1834–5 (20–33) ; plan of base-line and connections, *Meridional Arc* (pl. 30).

[5] *Meridional Arc* (xvii, n) ; see view of Dūn, now in GBO. Museum, probably by Peyton, which hung in Everest's study in London till his death.

The following are descriptions of the two terminal points of the base-line :

West End. ... Lat. 30° 20′ ; long. 77° 54′, ... about 2 miles to the E. of the small village of Sherpur, and about 1 mile S. from the Asan river.

A stone, 5 feet in length and 1 foot square base, was sunk to the surface of the ground, and lodged in a pile of masonry 14 feet square, with a circular pillar of masonry...disjointed from the rest of the pile in order that the instrument might remain isolated. Into the exposed surface of the central stone a piece of brass was soldered, on which was inserted a fine silver wire to receive the small dot which marked the limit of the base-line.

This was covered over by a circular brass plate, 2 inches diameter. ... The upper surface of the brass plate was left even with that of the stone. ... A parapet wall of 12 inches high was erected round the platform, and ultimately when the base was concluded the whole was built up to a level with this parapet, a supplementary stone of 1 foot square and 3 inches thick with a piece of brass, and dot soldered into it, being accurately placed over the dot in the lower stone by means of the centering telescope of the large theodolite.

For protection against cattle and other intruders a thick hedge of prickly pear was planted round the platform.

The station, ... when visited in 1867, was found with great difficulty. The prickly pear hedge had disappeared, and there was nothing to distinguish the station from the numerous mounds which were scattered around. For its future better protection...a tower was built over the masonry platform, ... and an arched passage 5 feet wide and 6 feet high to allow of access to the mark-stones. ... The tower is about 10 feet square and 8 feet high ; it has an external masonry staircase leading to the summit, which is horizontal to serve as a platform for future observations. ...

East End, ... lat. 30° 17′, long. 78° 1′, is situated on the extremity of one of the spurs of the...Siwalik range. ... The nearest village is Mohabawala, about a mile to the south-east. The Asan river winds round the foot of the spur, and one branch of it takes its rise in a ravine about 100 yards to the westward. ... Marked in the same manner as the western limit. ...

It was visited by Captain Branfill in January 1862, to be connected with the line of spirit-levels which had been brought up from Karachi. ... The level of the summit of the pyramid was determined as 1957·65 feet above the mean sea level. ... In 1867 a tower was built over the station similar to the one...over the west end. ... The mark in the stone on the summit of the tower is...1967·78 feet above the mean sea level[1].

SIRONJ BASE, 1837–8

On computation of the triangles between Dehra and Sironj, Everest found a discrepancy of about 3 feet between the length of the base measured by chain at Sironj in 1824–5 and that computed from the triangles. He recommended the remeasurement of the Sironj base with the compensation bars [16, 41], and this was undertaken at the end of 1837.

The camp proceeded...to Sironj, where they arrived under my charge on the 17th November[2] [41]. ... On the journey I encountered a very serious attack of illness which very nearly put an end to my existence, and for a long time rendered me quite hopeless for any active work, but my astronomical assistant, Lieut. Waugh, made amends by his zeal and energy, ... and all my subordinates were now so thoroughly masters each of his own part, that the measurement commenced on the morning of the 1st December, and proceeded just as satisfactorily as if I had been personally superintending...it.

As in the case of the base in the Dehra Dun, I took the precaution...to fix an intermediate station in the alignment (the nature of the ground not admitting of more than one), and two supplemental stations. ... Subsequent to my departure the inhabitants, incited by cupidity to possess the small portion of the brass which designated the intermediate site, broke the stone containing it to pieces, so that I was never able to derive any benefit from the precaution.

Regular comparisons of the compensation bars with standard bar A were made from stone pillars as at Dehra, 79 on 23rd November, and 61 on 22nd January.

The base-line was completed on the morning of the 18th January 1838, and the whole distance...amounted to 38,413·322 feet [7·28 miles]. The former base measured by the chain, after having been reduced to the value of standard bar A, ... gave 38,410·533 feet, ... so that the old measurement was too short by 2·779 feet. ...

---

[1] *GTS.* I (II, 47); map of 1867 shews both ends of base; GBO. Lib. A (7) [pl. 17].

[2] Waugh, Renny, Jones, Peyton, James, Keelan, Radhanath Sikdar, Terry & Parsick.

> The computed base of Sironj brought down from that of Dehra Dūn...[differed] from the actual measurement thus completed by 6·365 inches, which considering that the Sironj and Dehra Dun bases are separated by nearly 450 miles, and connected by 86 principal triangles, ... is as gratifying a proof of the accuracy of the series...as could be desired[1] [16].

Everest was the more delighted with the result as it meant that no intermediate base-line would now be necessary ;

> This chance is now entirely averted, and...one year's further delay is thereby struck off from the account. The principles...in which I was educated pointed out from 100 to 200 miles as the proper distance between two bases verificatory of each other, so that in carrying a series to the extent of 450 miles without an intermediate base I have acted contrary to established maxims. I did so in full reliance on the excellency of my instruments, and...the result has quite borne me out in my anticipation[2].

As he was already contemplating the remeasurement of the base-line at Bīdar, he left the apparatus in store at Sironj ;

> The apparatus is very delicate... and therefore not improved by travelling and, as any accident would be fatal, it was not without apprehension that I contemplated the late long journey over stony roads, the escape from injury during which I consider a great piece of good fortune. Besides the apparatus itself, there are framed tents, 17 in number, to protect the bars from the direct action of the sun. ...
>
> The next place at which the apparatus will be brought into use is in the plains of Beder, where I propose to remeasure the base of 1815, because it is one of the most uncertain of all those on the Great Arc, and at the same time one of the most important from its locality.
>
> The far better way would...be to deposit the whole apparatus, tents and all, at Seronj or in its vicinity, as soon as this season's operations are concluded. ... As Sironj is in a foreign State [Tonk], I cannot take so much upon myself without the authority of Government, ... though I look on the chance of accident as very remote[3].

The apparatus was therefore left at Sironj under charge of Sub-Assistant Martin, who was given the strictest directions for its proper care ;

> The standard and measuring bars are the most costly and delicate of the instruments. ... The iron bars are apt to rust, and if this takes place they will be rendered useless. The best means to prevent it is to cover them with mercurial ointment, hog's lard, or mutton fat. If either of the two latter are used, it must be applied in the state in which it is taken from the animal. ... If mercurial ointment is used, care must be taken...that none comes upon the brass bar, as it will create verdigris, and in time destroy the bar. ...
>
> To change the hog's lard, ... the old should be taken off and...the bars near the silver dots must be cleaned with a...soft brush and barley water, and with a dry brush the moisture must be taken up before putting on the fresh hog's lard or mercurial ointment, and if any rust has got upon the iron, you must rub it off with...slate pencil, taking care that it does not come near the dot.
>
> You must never touch the dots with your fingers, as the smallest piece of sand...would scratch the dot so seriously as would render the bar useless. ...
>
> That the lining of the boxes...be carefully preserved...from insects, ... put some leaves of the neem tree[4] into each box. ...
>
> The axis of the microscope is also liable to injury, either from the steel collars getting rusty, or from dust getting in. Goose oil is the best thing...to prevent rust ; mercurial ointment cannot be applied to the axis. ... To clean the axes, they must be wiped with a piece of silk or very fine cloth. ... The microscopes should be taken to pieces once in six months, and carefully cleaned. ...
>
> Dust and moisture, such as rain getting in, damp from the floor or walls of the building, will be injurious. ... You will have the doors and windows of the depot opened for 2 hours every morning...when the state of the weather will permit.
>
> You will yourself examine every article...at least twice a week. ... One of the greatest evils to be guarded against are the white ants, and you will order the tindal who remains at the depot to examine every box daily.
>
> You must take care that no combustible matter of any kind ever enters the Depot ; you should not permit even a candle to be taken in[5].

Unfortunately Martin had to hand over to a young assistant, Owen Mulheran, who broke down under the strain of solitary life and illness and, overcome by a form of religious mania, not only mutilated his own fingers and toes, but did the most extraordinary damage to the bars. Renny reports that

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[1] Report 3–8–39 (100–1, 105–6); fdbks. and comps., GBO. Comp. 6–6–15. [2] DDn. 342 (97–100), 23–1–38. [3] ib. (64–6), 1–12–37. [4] *Azadirachta Indica*, Parker (71). [5] DDn. 371 (148–8), 20–1–38.

> the steel bar A appears to have been originally lackered along the whole length of the inner side in a strip 0·9 inch in breadth. ... Of this lacker two inches from one end, and three inches from the other, have been entirely removed, and narrow strips here and there either entirely or partially rubbed off, the damage extending in all to about one fourth of the lackered surface. The brass bar, tongues, and case are in good order.

The compensation bars had been damaged in a similar manner, to a greater or less degree. The lacquer had been removed by a slate pencil, as suggested by Everest for the removal of rust, and had obviously been done under an honest misapprehension. Fortunately this removal of lacquer in no way affected the value of the bars for the purpose of precise measurement. The burning of his hands and feet was a ghastly business[1] [375–6].

BIDAR BASE, 1841

Though Everest had determined on the remeasurement of Lambton's base-line at Bīdar so early as 1837, as a natural consequence to the re-observation of the triangles south of Sironj and the error found in the Sironj base [41, 53], it was not possible to undertake the work before 1841 [16–7]. His request for this remeasurement was forwarded to the Directors[2], and the apparatus was despatched from Sironj about the 1st January 1840, requiring "34 camels and 3 elephants furnished by the Commissariat Department".

Waugh, to whose charge the remeasurement was entrusted, had searched for Lambton's base-line during 1838, and found no trace of it whatever. There was, therefore, no question of remeasurement. A new line had to be measured, and connected with Lambton's triangles by check on the surrounding stations where markstones could be found [17, 43]. The new line was located about 8 miles south-west of the old one, in the valley of the Manjra River near the town of Bīdar[3].

Although Waugh had selected the site and constructed the platforms in April 1840, permission was delayed, and actual measurement was not carried out till the end of 1841, when the party was strengthened by Mohsin Husain to provide against any trouble with the instruments, and by Jacob and two of his asssistants from Bombay [57]. Training was carried out during the rains, and

> on the 11th October, the necessary pillars...having been put up, the usual comparisons were made ; 57 prior to the commencement. ... By the 19th October the measurement was commenced, and was continued unremittingly, Sundays excepted, until the 4th December, when it was brought to a conclusion, having occupied 39 working days of 9¾ hours each. On the first day 8 sets only were measured ; on the 2nd December 23 sets were finished, which was the greatest number measured in one day. As the whole base comprises 660 sets...the average daily rate was 17 sets per day, or 1 set in 33½ minutes.
>
> The boning instrument was managed by Mr. Logan ; the microscopes by the parties named in the margin[4]. The trestles were laid, part of the time by Mr. Martin and J. Rossenrode, and subsequently by Mr. Fraser of the Bombay Longitudinal Series. ... Said Mohsin was also employed at the microscopes during...the ill health of Lieutenant Jacob and J. Olliver, Esq.

The measured length of the base, reduced for a height above sea level of 2,030 feet, came to 41,578·536 feet, or 7·87 miles, which differed from that computed from the triangles by 4·296 inches which,

> considering that the two bases of Sironj and Bedar are separated by a direct meridional distance of 425⅔ miles, and connected by 85 principal triangles, may be looked on as a highly satisfactory result, and strongly confirmatory of the accuracy of the whole series of operations.

On December 9th comparisons were again made against the standard. The measurement was confirmed by minor triangles as at Dehra Dūn, with two intermediate stations on the line of the base, and three supplementary stations to the south, to Everest's entire satisfaction ;

[1] DDn. 385 (56–8), (120–4) ; 20–1 & 24–11–38. [2] B to CD. 24–8–39. [3] TS. 7 (1/10–11), with charts p. 91. [4] Waugh, Jacob, Renny, Joseph Olliver, T. Olliver, Terry, Parsick.

> It would have been supererogatory for me to proceed...to the spot to superintend a work which either of these gentlemen [Waugh and Renny] was qualified and willing to perform fully as well as I could, and my absence at a distance of upwards of 1000 miles from my office might have caused a great delay to public business. ...
>
> On this account I entrusted the management...to Lieutenant Waugh. I detached Lieutenant Renny to assist him, so that in case of sickness of either...there might be no apprehension of delay. I placed at his disposal as many of my best sub-assistants as could be spared, together with the Mathematical Instrument Maker, Said Mohsin, and the greater portion of the artificers, furnished with a sufficient number of tools. ...
>
> Immediately on the conclusion of the base-line operation, the apparatus was all packed up, and the party commenced their march on the 11th January to rejoin headquarters. On arriving at Agra, all the large and valuable instruments were deposited in the garrison of that station, in a safe, dry, and commodious room, under charge of the Commissary of Ordnance, and Lieutenants Waugh and Renny arrived at headquarters on the 1st April[1] [1842].

BOMBAY SURVEY

The trigonometrical survey started in Bombay Presidency under Shortrede in 1828 had received the prior approval of the Supreme Government and of the Surveyor General [III, 130-1], but it was not until 1831 that it came under the direct orders of Everest [4, 72]. To his first questions as to how the base-line was measured, Shortrede replied that ;

> 1st. ...My operations were made to commence from a base line of about 4 miles in length on the Karleh plain, on the high road from Poona to Bombay. ...
>
> 3rd. The chain used was made by the late Mr. Cary, and by him adjusted to the exact length of 100 feet at the temperature of 62° Fahrenheit. I have therefore assumed it to be correctly of the Parliamentary Standard length[2].

Everest had the chain sent round to Calcutta for comparison against the new standard bar A [47], and made a number of criticisms regarding the measurement ;

> You have made no allowance for friction, and...have taken the length of the chain as being exactly 100 feet. Does that length mean the Parliamentary Standard or the scale of Alexander Aubert, Esq. [II, 254, 262]? There is some difference. ... The amount assigned to friction in the Beder base-line was 0·1109. Yours therefore may have amounted to about 1/10th of a foot, which term is omitted entirely.
>
> Your base-line is not continuous. At the end of the 54th chain you measure an oblique offset of 800 feet. ... Suppose the whole base-line had consisted of a set of such offsets, and then what would be said of it ? ... If the method of centering an instrument and the signal... were quite perfect, and there were no lateral refraction, and no error in the human eye or optical instrument, and no unequal expansion, it would be just as certain as actual measurement ; but...errors do accumulate in triangulation, do what we will. ...
>
> At the ends of the 5th chain, you observed a ramrod placed in the line, but you do not say what means you took to ensure its perpendicularity, neither...what precaution you took to avoid the effect of light on one side, and shadow on the other. ...
>
> You took an angle for your offset of 65° 49′ 31″·5, but you do not mention whether this was derived from a single observation, or the mean of several. ... As to the third angle, you make it supplemental, and assume it as a matter of course. ... The third angle should always be measured where it can. ...
>
> Why should not your base be as well measured as that of the Irish Survey ? This is not intended, any more than yours, for deducing the lengths of meridional arcs, but will be connected by triangulation with bases which have been measured for that purposes ; and so will yours, ... with a series which many persons think the first in importance in the world. ...
>
> You do not mention your boning instrument, and it does not appear clear how the apparatus was brought into alignment, or how the vertical angles...were taken. ...
>
> Under the article Trestles, you mention some of a particular construction, which carried the weight and drawing posts. You would oblige me much by sending me drawings of them, as also of those which support your coffers, for mine are very antiquated[3] [127].

Shortrede replied at length, pointing out that there were many details that, for the sake of brevity, had not been dealt with in his first report ;

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[1] Report 1842 (140–57) ; cf. DDn. 452 (2–3), Oct. 1843. [2] DDn. 323 (48–53), 20–10–31
[3] ib. (25–9), 5–1–32.

> I am not surprised that you should make several objections, which I hope in a great measure, if not entirely, to remove. To...your general remarks I entirely agree. They contain exactly the principles by which I have endeavoured to direct every part of my operations. ...
>
> For holding the ramrod a hole of about 6 inches deep was drilled in the middle of the screw of one of the highest trestles. The hole was bored very nearly of the size of the ramrod, but was made to fit perfectly, yet easily, ... by shellac melted by the ramrod heated.
>
> The alignment and perpendicularity of the ramrod was ascertained by the theodolite, ... as did also Mr. Sundt [III, 382–3] by a plummet. The point observed by both Captain Jopp and myself was about an inch above the top of the trestle, so that even if it had not been perpendicular no sensible error could have arisen on that account. Both Captain Jopp and I found it [necessary] to have the ramrod screened from scattered light, and accordingly Messrs. Webb and Sundt stood behind it, so as to enable us to see it...distinctly. ...
>
> Though my base was not intended for deducing the length of meridional arcs, nor of perpendiculars to the meridian, I never supposed myself entitled to take any liberties in the measurement. ... I am well aware that my work will be connected with that of the great survey, which undoubtedly is the most important in the world. ...
>
> Of course it does not belong to me to judge of my own work, and though I know of no particular cause of errors in the measurement, yet my private opinion is that they may amount to about 2 inches, and can scarcely amount to more than 4 or 5 inches[1].

Everest agreed that

> the operation has been conducted altogether in a masterly style, quite in keeping with the rest of your performance, nevertheless I...consider the want of continuity a great eyesore. ...
>
> You have the bases of Melun and Perpignan to bear you out[2], but not Colonel Lambton's, who would be very sorry to contest with you the claim of priority. ... The break in the base at Bangalore...was unintentional, ... but that base was afterwards remeasured, and the disjointed base forms no part of the work of the Great Trigonometrical Survey [II, 255–6]. Consequently the base in the Karleh plain stands alone distinguished by that feature. ... I should be exceedingly glad to see it replaced by a full length base without a break[3].

Several years later Jacob called attention to this request and reported that he had found a suitable site to the west of Poona[4]. Everest did not think a new base would meet the approval of

> the Hon'ble Court of Directors, or of the Supreme Government. ... The base of verification of the Calcutta Longitudinal Series showed a disparity of upwards of 12 inches per mile, and this the Government have pronounced to be unimportant [19].
>
> Now, it is hardly likely that so large an error will have generated in your work, and indeed the base at Karleh will serve to shew whether the result is correct within that limit. ... Therefore, under the present decision of my superiors, I think it better that the Bombay Longitudinal Series should rest entirely on the base at its origin near Beder [74].

He took the opportunity, however, to invite Jacob to join Waugh's party for the measurement of the new base-line near Bīdar [55][5].

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[1] DDn. 323 (74–84), 6–4–32. [2] measured by Delambre & Mechain, 1792 ; Gore (151–4). [3] DDn. 323 (35–46), 15–9–32. [4] in which locality a base was measured 1933–4. [5] DDn. 325 (232–3), 24–5–41.

CHAPTER V

PRINCIPAL TRIANGLES, SUBORDINATE SERIES

Calcutta Longitudinal, 1830–2 — South Parasnāth Meridional, 1832–8 — Budhon, 1833–43 — Ranghir, 1833–42 — Amua, 1833–9 — Karara, 1838–43— North Connecting Series, 1841–4 — Shortrede's Triangulation, Bombay, 1830–5 — Bombay Longitudinal, 1836–42.

DURING Everest's absence from India between 1825 and 1830 the Great Trigonometrical Survey had been employed under Joseph Olliver on a longitudinal chain of triangles starting from the Great Arc near Sironj, and working east towards Calcutta[1] [III, 261–4]. By 1830 the triangles had reached the difficult flat country round Burdwān, and Everest asked that

> Mr. Olliver might be ordered to Calcutta, in order that I might inspect the documents of the work carried out in my absence. ... He arrived on the 28th October 1830, and remained here until the latter end of December, during which time I examined most carefully all his angle books and records, and sent a report to Lord William Bentinck on the 24th December[2].

Olliver and his assistants[3] had been working under severe handicaps, the chief of which was the poor quality of the 18-inch theodolite, the best available [III, 259, 261, 264 ; IV, 143]. The system of observation to which Olliver had been trained, and which Everest had laid down, made insufficient provision for elimination of instrumental or observation errors. In adapting the telegraph towers, or constructing new ones, no provision was made for isolating the instrument [81]. The work was far below the standard required for principal triangulation.

At no time did Everest impute blame to Olliver for these defects, but he took immediate steps for the measurement of a base-line on which the triangles should be closed, and their errors determined. This measurement was made along the Barrackpore trunk road between October 1831 and January 1832, and Olliver and his party were brought in to assist [48–50].

The results of this connection confirmed Everest's fears. There was a linear discrepancy of about eight feet in the closing side[4], and a vertical discrepancy of 200 feet in height [94], errors that were the more regrettable since they must affect the initial values of the several subordinate meridional series that sprang from Olliver's work. Though to the professional surveyor these errors stamped the longitudinal series as unworthy of confidence, Everest was unable to persuade the authorities either in India or London of their serious import [6, 18–9].

Along his northern stations, at intervals of about one degree, Olliver had made astronomical observations for azimuth, and it was from these stations that Everest proposed to run a number of meridional chains of triangles northward across the Jumna–Ganges plain. More reliable values for azimuth were determined on the start of these meridional chains, and under Waugh's directions of June 1853 all errors were systematically distributed along the longitudinal series, which was entirely re-observed between 1863 and 1865[5].

Starting from the west, these chains, or series, took the names of Olliver's stations, Budhon, Ranghir, Amua and Karara, which ran to the north, whilst the series starting from Parasnāth was taken to the south in order to connect up Buxton's work of 1821 [13 : pls. 11, 24]. Two other series, Chendwar and Gora, were started in October 1843, and are left to a later volume [14][1].

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[1] *GTS.* V (iii-vii—B) ; *GTS Syn*, xii ; GBO. Comp. G-5/10. [2] DDn. 283 (25), 5–2–32. [3] Rossenrode, Torrick, Peyton. [4] Report 21–8–39, (68) ; *GTS.* II (71). [5] Waugh's MSS, II : DDn. 594 (425) : *GTS Syn.* xii (vii—B) ; Instns. for revision, DDn. 46 (272), 14–10–63.

SOUTH PARASNĀTH MERIDIONAL, 1832–8

Everest judged that the meridian of Parasnāth[2] "if produce to the...southward... would pass through Cuttack and Juggernath, which is nearly in the parallel of 20°, three degrees being hilly, and the remaining degree alluvial"[3]. He strongly recommended that triangulation of the southern section should be put in hand as early as possible, in order to connect up Buxton's survey,

> which, since that gentleman's death, ... remained in the Surveyor General's office as so much waste paper [III, 17–9 ; IV, 13]. ... This work, so far as it goes, is superior to all the materials belonging to the Surveyor General's department, excepting always Captain Herbert's survey of Gurhwal, and the Nagpore survey by Lieut. Norris. . .
>
> Whilst the base-line is being measured in this vicinity [Calcutta], I shall not be able to spare any persons competent to undertake such an operation, but when it is concluded...I can detach Lieut. Western and Mr. M. Torrick[4].

Approval was prompt, and on 6th February 1832 Western was placed in charge, with two sub-assistants[5], a native doctor, 14 *barkandazes*, and 34 followers, and directed to start from Olliver's work south of Parasnāth. After several weeks on reconnaissance and selection of stations, Western observed at one station only before retiring to Midnapore, where two additional sub-assistants joined him[6].

During season 1832–3 the country to the south was so disturbed "by the insurrection of the Kols and Chuars [1 : 294]" that, rather than sanction a large escort, Government suggested that the party should work the series northwards of Parasnāth. Western was repeatedly ill and writes from Suri, 1st January 1833 ;

> Little has been done during the last month as, having obtained sights on Parasnath Hill on the 9th, ... I descended on the 10th, and was seized with a severe attack of fever on that day. I then proceeded to a secondary station where I took the angles, and continued my march towards the next primary station, but, having got worse and worse every day, on the 17th I left the party for...medical advice at this station. ... The Civil Assistant Surgeon... thinks it necessary for me to wait here another fortnight. ...
>
> Not being able to trust the large instrument in the hand of any of the sub-assistants, I have directed Mr. Torrick to carry on an approximate series in the meantime[7].

What with illness and inexperience, Western maintained little control, and his two senior assistants were discharged for indiscipline [372]. He had difficulty in finding suitable intervisible stations, and had trouble with the villagers :

> On the 13th I selected two [stations] which appear to be very eligible ; they are tank banks. On commencing to cut the trees, I had to clip one or two banian and pipal trees that obstructed the view, ... to which no objection was offered, but when I commenced on the mango trees... the natives no longer stood passive spectators ; they used their tongues, and threatened to use their sticks. I continued cutting without coming to violence with them, and only stopped on finding that there were houses intervening that entirely obstructed the view. ...
>
> I have no money to incur contingent expenses[8].

Everest found the work of season 1832–3 so full of serious errors that,

> but for my apprehension of injuring the early career of a young man of promise, I should then have brought the circumstances to the notice of Government. ... It seemed to me better to give Lieut. Western an opportunity of redeeming his pretensions[9].

But season 1833–4 was no more successful ;

> The country to the south was considered sufficiently settled. ... Nevertheless, when he reached his ground, Lieutenant Western found it necessary to apply for...a small military escort. The months of November and December were spent in inactivity. ... During the season observations were taken from ten stations but...the primary triangles were still so full of large errors as to render them utterly unfit for the Great Trigonometrical Survey[10].

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[1] Instructions to Logan for Chendwar and to James for Gora, DDn. 431 (263–9), 10–9–43. [2] a prominent isolated hill whose top, 4,480 feet, is covered by Hindu temples. [3] DDn. 265 (261–91), 12–10–31 ; para 26. [4] ib. (315–6), 17–11–31. [5] Murray Torrick & Edward Boileau [384–5]. [6] Andrew Torrick & John Thornton [385]. [7] DDn. 330 (3). [8] from Moughyr ; ib. (71–3), 1–6–33. [9] DDn. 286 (134–7), 27–5–34. [10] *GTS Syn.* xiii A (v).

In September 1834 Western's services were dispensed with, and the party took the field under Bridgman, who had only had a few months training on the Budhon series [61]. He had been on sick leave for nine months the year before, and his health soon broke down again. He took sick leave in February 1835, and died at sea two months later. Field work was suspended, and the party remained under Thornton's charge till the end of 1835, when Alexander Boileau took over. After four months

> he returned into quarters [at Bankura] ; ... himself, his native doctor and half the establishment of lascars, and two-thirds of the sepoys and barkandazes, being afflicted by sickness. ... The observations he had taken at 5 principal stations were...so discordant as to be unworthy of confidence, owing to some defect in the 18-inch theodolite [143]. ... Up to the middle of...1836, no real progress had been made. ...
>
> Messrs...Torrick and Thornton, having resigned, ... were replaced by Messrs Kallonas and Brown [375, 384]. During the ensuing season, 1836–7, eight principal triangles were completed, ... after which, on the 8th May 1837, the party went into quarters at Midnapore, from whence, on the 28th July 1837, Lieut. Boileau proceeded to China on medical certificate for 6 months.

Both his assistants being on leave, Boileau left the party under charge of a military officer till Kallonas rejoined two months later. Kallonas took the field in November to continue the approximate series to the south, but suffered from "bilious fever" and did little more than clear a few hill tops.

> The country for many miles to the southward...is a vast hilly wilderness, with not the least trace of a footpath intersecting its dreary solitude to shew that there was human habitation in the neighbourhood, and it is so much infested by tigers, buffaloes, elephants, and others savage beasts, that it is impossible for a party of only 4 or 6 men to journey through it without feeling a constant apprehension of impending danger[1].

Boileau arrived back in Calcutta on 23rd December, and took the field from Midnapore at the end of January with a military escort. He again had to make an early return to cantonments owing to

> fearful sickness and mortality among the camp followers, 62 people out of 107 being either sick or dead, and both of the sub-assistants with the native doctor too ill to remain in camp[2].

He reported the following season that he had

> for the last three weeks been endeavouring to fix Lieut. Buxton's stations. ... The country is so difficult that I have been more than 13 hours, or from before daybreak in the morning until 7 o'clock at night, travelling a distance of only 11 kos, or 21 miles. But my people have been working hard, and when we complete our (connection) with the old hill stations...I will take an early opportunity of forwarding the results[3].

After continual sickness Boileau lost heart for the survey, and left in December 1838 to take up a more congenial appointment in Calcutta, leaving Kallonas to complete the connection with Buxton's work, which he did in June 1839. The party was then broken up and all useful members transferred to Dehra Dūn.

Everest was greatly disappointed both with the progress and quality of the work. Several of the triangles contained acute angles of less than 30°, and the triangular error in general was far too high, for which the theodolite was largely responsible [143]. The series was excluded from the final reduction of the Great Trigonometrical Survey[4].

The slow progress had been partly due to the abominable climate, and partly to lack of contact with the invigorating personality of the Superintendent ;

> Experienced officers were not available, and the work was carried on so far from headquarters that little effectual supervision...could be exercised. ... Lieutenant Western, although an officer of superior talents and mathematical attainments, was...quite a youth, inexperienced in command, unversed in the practice of geodesy, and unacquainted with the character and customs of the natives.
>
> Lieutenant Bridgman...fell an early sacrifice to the climate, and Lieut....Boileau's health also suffered from the same cause. This enterprising officer on assuming charge had actually to commence the work de novo, and carried it on to within a short distance of its southern limit Great progress, however, might...have been made if the principal series had been confined

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[1] Kallonas to Boileau, 8–2–38 ; DDn. 370 (32–4) ; W. Midnapore, fitly called "Jungle Mehals". Report for 1837–8, DDn. 344 (301). [3] DDn. 370 (53), 20–12–38. [4] *GTS Syn.* xiii A (iv) ; TS. 13(i).

> to a simpler form, whereby the time and labour which was consumed in multiplying observations...would have been spared[1] [70].

BUDHON, 1833–43

The Budhon series was the most westerly of the meridional series, about one degree east from the Great Arc, longitude 78° 30′. Starting north of Saugor it passed through Jhānsi, and Gwalior, and then

> descended into the valley of the Chambal and Jumna, requiring henceforward the aid of towers, and the heavy labour of ray-clearing, which greatly retarded its progress. ... It passed through the districts of Agra, Mainpuri, Etah, and Aligarh, striking the Ganges in latitude 28°, whence it was continued...with shorter sides arranged in five polygonal figures...to the...foot of the Himalayas, and closed upon stations of the Great Arc and N.E. Longitudinal Series...in the year 1842–3, a period of ten years having been occupied in completing about...400 miles[2] [pls. 4, 11].

Macdonald, a very capable revenue surveyor, set out from Calcutta on 23rd November 1832, with W. N. James and Scully as assistants. They reached

> Mirzapur on the 30th December, and were detained there for two days, hoping to get the two bullocks that carried the office tent relieved, but the officer in charge...there...would not grant the cattle as some form was omitted in applying for them. ...
>
> I pushed forward...[to] Saugor. On the last day of January we had procured the necessary material, working tools, flag staves, etc., and marched the next morning towards Boodhan, but the General having objected to countersign the order we were recalled, but again furnished on the personal responsibility of the Commissary.
>
> On the 2nd Feby. we reached Boodhan, ... the base of which is girt with dense jungle, the retreat of tigers and panthers, which kept us on the alert during our stay[3].

The first stations selected, observations were started in March, when the party was visited by the Surveyor General [24], who dropped two more sub-assistants[4], and

> found everything proceeding in the most orderly and methodical manner possible. All parties seemed to be highly zealous and alert, and...my visit greatly served to promote that uniformity of system, without which it is in vain to hope for success[5],

In May observation was interfered with by hazy weather

> and by obstruction...from the inhabitants, who regarded the survey...with suspicion and dislike. ... Macdonald endeavoured to complete another triangle, but failed, although he waited at Sirsaud...from 13th May to 25th June without having a single good night for observing. Indeed the length of the rays —...over 30 miles — was too great...unless the air were cleared by a general fall of rain. The party then went into recess quarters at Saugor.
>
> The outturn...for the first season...shews but three principal triangles completed, covering about 1,000 square miles, and stretching to a point nearly 50 miles north of the origin. ... But a good deal of secondary...triangulation had been accomplished[6].

Macdonald asked whether topographical detail should be sketched in [13];

> All the secondary and tertiary angles have been protracted...on the scale of 4 miles to the inch. ... If the three sub-assistants...are to remain with this party, ... I may be furnished with another theodolite, or, if you wish the principal features of the ground or the rivers laid down, perhaps a planetable might be put into the hands of one of these sub-assistants. They are mere beginners, and...my object...is that there may be employment for every individual. I only require one assistant at the large theodolite, and I find Mr. James of essential service.

to which Everest replied that he intended to leave only

> one sub-assistant besides James permanently with your party. The other two are sent to learn their work and will eventually be removed. ... I send you an extract containing Lord William Bentinck's decision [14]. ... I shall be happy to see a successful use of the plane-table, but — mark well — no sacrifice of time or money must be made to it[7].

Bridgman who had been posted to the party was delayed by sickness and did not start work on his secondary series near Gwalior until April. He had accomplished little by the end of July when he was transferred to the Parasnāth series [60]. Later one of the new sub-assistants, Cropley, died at Saugor ;

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[1] TS. 13 ; pt. 1 (1–4) ; GBO Comp. G. 6/6 (1–4), 1–7–48 ; *IO Cat.* (22) ; lay-out vastly simplified during later computations. [2] *GTS.* VII (ii–iv, J). [3] TS. 9 (1–7) ; GBO Comp. G. 5/12. [4] Cropley and Loane. [5] Report 21–8–39 (35). [6] *GTS.* VII (v, J). [7] DDn. 374 (22–5, 47–50), 1–7 & 15–10–33.

The lamented death of Mr. Cropley is a great loss to this survey. ... Mr. Loane is...endeavouring to revise the angles connected with those distances which...in last season's work showed the greatest discrepancy, and were marked by you 'to be done over again'. Mr. Scully is in advance with the plane table, laying down the approximate positions of heights that may be made secondary stations.

Macdonald was a great worker, full of initiative and ideas. He had the same sort of trouble with his blue lights as Everest was to have on the Great Arc [29–31], and writes from Dhundkooa [Dhandkua, pl. 4] ;

On the 12th, men were dispatched with blue lights...with orders to light them at fixed intervals which they were to estimate by counting certain numbers by the beat of the pulse, ... each man beginning to count as soon as he sees our signal light, and blue lights being let off at Dhundkooa for every round of observations. I had hardly hoped for success at first, and was not therefore much disappointed at the failure. ... We have again despatched fresh messengers to the offending stations, and hope this night will be more successful. ...

14th. We were again disappointed last night by the bungling of our blue-light men, and a fair night lost. Bearers were despatched express to order the common lights for this night. ... Weather cloudy. ...

16th. Yesterday we had a heavy fall of rain, but the evening cleared up and turned out very favourable. ... Unfortunately, however, the two stations which we wanted most were invisible, viz., Kuthera and Gwalee. ... The man who was dispatched to Gwalee with blue-lights never reached that station, but after an eccentric circuit returned this morning after an absence of 4 days. ...

17th. This morning at 3 a.m. we began the...azimuth, but were too late for the greatest elongation, the time of the chronometer that was calculated being wrong. ...

18th. We began the work last night under very promising auspices. Both Gwalee and Kuthera showed beautiful lights, ... but the lights soon began to blink and glimmer, and about 10 or 11 became invisible. 10 Rs. of oil have been expended on Gwalee without our being able to see the light, and it remains to be seen whether the wrong line...was taken up, ... or the view intercepted by some trees[1].

The Gwalee lights were eventually successful, but Macdonald was troubled by discrepancies [91] ;

As I do not yet feel that confidence...that is obtained by a long...experience, ... these ...may...be...attributed to my deficiency, ... but...the alternate observations being taken by Mr. James—who is...an accurate observer in general—and proving equally discordant, I am rather inclined to attribute the...error to the unsteadiness of the lights, ... the weather being so windy, and the distances so great, as to render it difficult to intersect a flare that is exposed to windward, and a moderate light cannot be seen at such distance.

We must...resort to...blue lights but, having already failed in various attempts to regulate their burning at more than one station on the same night, we can only take each station with the reference lamp separately, and thence deduce the several zeros for each angle[2] [91].

There were occasional incidents in Orchha State ; Macdonald sent a man to

Burwa Saugor with a request couched in the most polite terms...to request the Killadar to permit our flag to be erected on his highest bastion, that the position...might be determined. ... The Killadar replied that it could not be permitted, for when the Governor General passed through Jhansi last year, the Rajah allowed the English flag to be hoisted on his fort, and ever since that unfortunate day, the whole raj had been the prey of loot and desolation.

Had a visit on the hill from a Brahman who had lately been plundered and stripped by the robbers who are infesting the country. He was, however, released and his clothes restored on declaring himself to be a resident of Kuthera, 'Go thy way. ... We loot Mahrattas and their dependents, not our brethren of Kuthera'. There were 50 matchlock men, or sepoys, and about the same number of latheewalas[3] in this band. ...

The Kuthera Rajpoots are very candid and freespoken ; they confess that although their juwans[4] receive pay from the Soobah and swell his ranks, yet that they are in the league with Tehree and the Poomars. This prevents their losing caste with their Boondela brethren.

A man sent to Koror fort to solicit the Killedar's permission to put up some mark for intersection brought back a polite letter saying that the fort was sacred to a deota[5] who was celebrated as a...destructive being, and would surely cut off anybody who would attempt to raise a flag on his premises ; a piece of presumption that had never yet been attempted. ...

[1] Journal, 13-11-33, TS. 9 (1-7). [2] DDn. 373 (39-42), 2-12-33. [3] men armed with heavy staves. [4] young men. [5] sacred spirit.

> Informed that a chuprasee passing near this place, and bearing letters from the Resident of Gwalior to Humeerpoor, was lately murdered in the neighbourhood. Informed also that the bodies of 200 slain last month at the fight of Raneepoorah strewed the field unburied[1].

He writes from Algi, 15 miles west of Jhānsi, that his men had begun to

> waver, fancying the charm by which they...have been hitherto protected has been broken; and several have given warning that they will take their discharge, rather than expose their lives and property to danger. ... The Governor General's Agent, Mr. Scully, and three suwars, have been stopped by...matchlock-men and obliged to seek safety by flight[2].

An attempt made to connect with the Great Arc south of Gwalior having proved unsuccessful, field work was closed on the 1st of June and,

> when the party marched into recess quarters at Agra, where it arrived on the 30th. In all, twelve new principal triangles had been measured, extending the series to a point near Gwalior. ... The secondary triangulation...was considerable, the points fixed being numerous and fairly well spread. ... Some of the chief secondary stations were made to form a minor series. ...
>
> The preliminary selection of the stations in advance was carried...well into the plains across the Chambal and Jumna rivers[3].

On Macdonald's report that towers would be required across the *doāb* north of the Jumna, Everest doubted

> whether Government will ever consent to building towers for any but the Great Arc. I have found in my late operations that there are hardly any situations in this doab in which, by the help of a staff 70 or 80 feet high, and a pile of 12 feet, blue lights may not have been seen at 20 miles distance. To effect this, however, it is necessary that all intervening trees be cleared away, and...that a minor degree of accuracy be deemed sufficient, for a blue light burned at the top of a staff...can never be properly over the centre of the station[4].

After a reconnaissance Macdonald persisted that towers would be essential

> to obtain symmetrical triangles. ... although a series somewhat distorted in form could be carried on with...the long masts, by means of forts, high buildings, and mounds, that are scattered over the country but, as your...letter...particularly enjoins...symmetry, we shall... fix the sites of future towers, merely tracing the rays according to your instructions[5] [31–2].

During season 1834–5, therefore, Macdonald worked northwards across the Jumna, selecting stations by the "ray-trace" method with small theodolites and perambulators, and brought his work across the Ganges. He was too ill to continue field work after April, and taking sick leave in September died at home two years later. He was relieved by Ommanney who had joined at Agra in June 1835.

Ommanney took the field in November with only one assistant, Scully. As no authority had yet come for the erection of towers, he spent the season running trial lines between the sites selected by Macdonald without actually clearing them. The villagers at first refused to allow trees to be felled but, after special orders had been obtained for the payment of compensation under the supervision of civil revenue officers [67], approximate observations became possible.

During season 1836–7 Ommanney made final observations from the neighbourhood of Gwalior to his first tower, Atgath, on the north bank of the Chambal. This was only 26 feet high, sufficient for the back rays only, and had to be rebuilt in 1840 and raised another 10 feet. The rest of the season was spent in laying out sites of towers across the *doāb*, without much success.

On 31st May 1837 Ommanney resigned, handing over charge to Joseph Olliver, his only assistant. Given one assistant, Driberg, Olliver had to make a fresh start north of the Chambal during season 1837–8, for Everest directed that

> instead of a single series of triangles whose sides are from 15 to 20 miles, you will range them in double series so as to form a polygon round a central point with sides not less than 8 miles and not greater than 15 miles [6, 76]. ... For 8 miles no artificial elevation at all will be required but in all cases the ray must be cleared. ... You will be able to turn to account many of the artificial mounds which now obstruct the view in long distances. ... You will at all times be able to see either the heliotrope or night light. ...
>
> So much time has been already expended in vain on the Budhon Series, and it is so disreputably in the background, that I do not wish you to give up any work already executed by your predecessor which will serve[6].

---

[1] TS. 9 (27–8) Comp. G. 5/12. [2] DDn. 373 (46), 1–2–34. [3] *GTS.* VII (vi–vii, J). [4] DDn. 373 (63–5), 1–6–34. [5] ib. (106–9), 6–9–34. [6] DDn. 371 (127–8), 2–6–10–37.

Olliver spent five months preparing stations north of the Jumna, with low towers and mounds. The tower at Firozābād on the north bank—built of mud under Ommanney's direction—had fallen down during the rains, had been rebuilt, and fallen again. It fell yet a third time after being raised to 40 feet. Work was closed down in March 1838, and the establishment placed under Renny for work on the Great Arc [42]. Everest records that progress on

> the Budhon series, though highly prosperous and satisfactory as far as the hilly country lasted, yet ceased to be so as soon as the operations entered the flat lands to the north. ... It is hardly fair to censure any party for not succeeding in a matter utterly new, and before untried. ... The mistake...by Lieut. Macdonald originally was...selecting the stations at too great a distance from each other. ... Experience has now been acquired...respecting triangulating in flat countries which will probably...ward off...a like mistake[1] [6, 84 ; pl. 4].

The series was resumed in November 1839, with Renny in nominal charge, but as he was still required on the Great Arc, Murphy carried on for the next two seasons[2]. By November 1840 he had taken the re-designed approximate series to the neighbourhood of Morādābād, and then returned south to bring up final observations from the Chambal where Ommanney had left them in December 1836. He worked up to the Ganges, and then, after laying out a further polygon near Morādābād, took the party into recess at Dehra, 4th June 1841.

He spent the whole of season 1841–2 laying out triangles northwards to parallel 30°, making junction with the Great Arc north of Meerut, and with Du Vernet's Himālayan series [71]. Towers were built, and all stations north of the Ganges were ready for observation the following season[3].

To ensure that field work should be completed during season 1842–3—Everest's last in charge of the department—three parties were formed under Renny, James, and Logan, and these observed the principal triangles north of the Ganges, all vertical angles north of the Chambal, and astronomical azimuths right through the series[4]. They were inspected in the field by the Surveyor General, and by the middle of May 1843 all work was completed and the three parties marched into Dehra[5].

RANGHIR, 1833–42[6]

Ranghir was the second series from the west, generally following the meridian of 79½° as a chain of single triangles[7].

> For the first hundred miles...it crosses the low hills, ... Saugor, ... Jhansi, ... Hamirpur, and ...the Bundelkhand Agency. It then enters the great plains of the Gangetic valley, ... and after crossing Etawah, Farrukhabad, ... and Bareilly, terminates in the forests of the tarai[8] [pls. 4, 11].

Charge was allotted to Waugh, whilst that of the Amua series to the east went to Renny. They had joined at Calcutta during 1832, and spent some months with Rossenrode on the Great Arc approximate series [24], so that, after raising their parties at Agra, they were ready to tackle their own series with confidence.

Leaving Agra on 30th November 1833 with two sub-assistants[9], Waugh reached his starting point, Ranghir, on 6th January. He commenced by taking circumpolar observations for azimuth, his new value being adopted for the series in preference to Olliver's [58]. He then spent several months trying to find suitable stations for a break-out from the side Ranghir–Tikaria, as directed by Everest. This was 30 miles long, and the high ground to the north was "a mountainous table-land of considerable breadth, covered with high forest trees and dense underwood, and devoid of any commanding eminences". He built a tower 35 feet high, the first ten feet of stone in mud, digging special wells to get the water. When this gave out, the remaining 25 feet were run up in dry stone, "and it came tumbling down almost immediately after completion "[1]. He abandoned the attempt, and asked permission to lay out his triangles to the east of Ranghir.

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[1] Report, 21–8–39 (44–5).

[2] with O. Mulheran & Glynn.

[3] discrepancy of 6·24 feet on 21 mile common side.

[4] Instructions to Logan and James, DDn. 431 (227–8), 27–10–42.

[5] *GTS*. VII (xiii–xv, J) Final Report, TS. 9, 1 ; *IO Cat.* (15–7).

[6] *GTS Syn.* xv ; TS. 9, 1, ii.

[7] with a single trigon near Farrukhābād.

[8] *GTS*. VII (iii–K) ; MRIO. 97 (9) ; 8 m. map ; between meridians 79° and 81° covering lines of Ranghir & Amua series. SGO. 1834.

[9] Armstrong & Forster.

Everest's approval took many months to come, as he was fully engaged on his reconnaissance north of Delhi, but Waugh's new line was favourable, and he made rapid progress, staying out till the end of July to take advantage of the clear air after the early rains. He completed observations at no fewer than nine triangles and wrote to Everest on 21st July,

> having last night finished...at Phara hill station. The observations have occupied 31 days, during which...we have marched upwards of 300 miles over the treacherous and loamy soil of Bundelcund. We lost 6 days from bad weather. ... We are all in good health and spirits, and the constant exposure to the inclemency of an unusually severe season has produced no symptoms of sickness in camp. The men, however, are a good deal worn down by the harassing nature of their duties, ... rendered more arduous by a long series of forced marching in rain and mud. They stand in need of rest, and...I proceed...without further delay to Cawnpore. ... The rapid delapidation of our camp equipage, and the difficulty of obtaining supplies of food in a land afflicted with famine are additional reasons[2].

The party took the field again on 10th October, and commenced the lay-out of new stations to the north of the Betwa in the flat country south of the Jumna, finding a number of mud forts and high mounds that served instead of special towers. Being called to Dehra Dūn to assist in the measurement of the base-line, Waugh left Armstrong to carry on till his return towards the end of May. By the end of June, when they moved into recess, triangles had been selected as far north as Bareilly, and some of the rays cleared. Waugh was warm in praise of his assistants, Armstrong and Forster.

It was decided that the towers in the plains should consist of a central masonry pillar to carry the theodolite, with a portable wooden scaffold for the use of the observer, his attendants, and the observatory tent, this scaffold being moved on from station to station [84]. As sanction to the construction of towers had not been received by the time the party took the field in October 1835, work was confined to the clearing of rays, the selection of forward stations, and secondary triangulation for geographical work. On Waugh being again called away [39] Armstrong was again left in charge for season 1835-36 ;

> Ray-clearing and approximate measurement of the angles was carried on...under many difficulties, until the 22nd of June, when the rainy season set in with such violence as to prevent further operations. ... Fourteen rays had been cleared and approximate angles measured...up to...Bareilly. Five stations were selected further north...to the outer Himalayas[3].

Meanwhile the Executive Engineer started work on the ten masonry columns after Waugh's design. A typical cause of delay occurred at Atsu, in Etāwah district. A suitable site had been promised by the local *zamīndar* the year before, but when the overseer wanted to start construction, frivolous excuses were put forward and private building started round the spot. After long correspondence, and several interviews, the *zamīndar* won his point, giving another site in exchange which entailed the clearing of fresh rays.

Recess was spent in Bareilly, and designs put in for another 14 masonry columns, and Armstrong then started final observations from the southern end. The scaffold made up by the ordnance department at Cawnpore took ten bullock carts for its transport. Work was proceeding well when, on the night of 10th April, the scaffold caught fire, and the theodolite so damaged that all further work had to be abandoned for the season. Armstrong was overcome with shame ;

> I proceeded to the scaffold about 4 o'clock p.m. to ascertain the practicability of seeing the Etawah blue light. ... I deputed the two tindals...to cut down a pipal tree which appeared likely to intercept the ray. ... A little before sunset I came down to dinner, and proceeded up again at about 6 o'clock...for the night observations.
>
> At about ½ after 9 the vase light at Bessumgarh became visible, and having observed the vertical angles...I covered up the instrument, intending to pack it up early in the morning.

---

[1] Report to SG. 5-5-34 ; DDn. 379 (73-7). [2] ib. (93-4), 21-7-34. [3] *GTS*. VII (x—K).

> I came down...at about 10 o'clock, a pair of massals [torches] having been burnt previous to my descent as a signal for the people at the referring lamp to put up for the night. According to the usual practice a guard of khalasis...were...on the scaffold to give warning of any change in the weather, ... and a joint guard of sepoys and burkandazes below...the scaffold. ...
>
> I retired at about 11 o'clock, but had scarcely been in my tent 15 minutes when I heard of the scaffold being on fire. I made all practicable haste to...the station (about 300 yards from camp), but before I arrived there the devouring element had exceeded the power of any human being to extinguish. However, threats and rewards were held out to the people, and several were on the top, attempting...to cut away the tent ropes and throw down the tent, ... and they retired only when their lives were in imminent danger.
>
> The range of the fire was increased by the wind...and it is with the deepest misery I add that I was a helpless spectator of a disaster with which the ruin of my...reputation must be closely connected. When the fire had consumed...the scaffold, the instrument was found isolated on the top of the pillar, and it appeared at the moment to have escaped. ...
>
> Early this morning...I ascended the pillar and took down the instrument by pieces.
>
> How this fire originated I feel myself unable to say. ... Every lamp in the observatory was extinguished, and the tent closed. It appears that the massals which were used to signalise to the referring lamp were not entirely extinguished, and that the wind acting upon the torch caused the embers to increase to a blaze which set fire to the tarpawlins used in sheltering the musalchies' quarters from the wind[1].

Waugh passed on this distressing report with the pious comment that,

> with so careful a person as Mr. Armstrong is, one would have thought accident impossible, but as Providence sends rain upon the just and the unjust so do misfortunes happen to the careful as well as to the careless[2].

Starting season 1837–8 with a fresh theodolite and new scaffold Armstrong was at first delayed by adverse weather and dust. He was held up later by "unprecedently windy and dusty" weather, and moved into recess quarters at Fatehgarh in May. He now regretted that the triangles had been laid out with such long sides "rendering the observations dependant upon the variable nature of the atmosphere and refraction", and forty years later General Walker comments on

> the constrast between the rapid completion of the lower third part of this series...in a hill country, with the slow execution of the upper two-thirds...in the plains. ... The principal cause of the slow progress in the plains was that the sides of the triangles...averaged 18 to 19 miles, and occasionally exceeded 22 miles, ... much too long for satisfactory observations. ...
>
> Thus the measurement of the horizontal angles proceeded very slowly ; that of the vertical angles had frequently to be performed so long after the time of minimum refraction that simultaneous reciprocal verticals were often essential to...even moderate accuracy, and this not only necessitated the employment of a second observer, with a complete...equipment, but greatly retarded the progress. ...
>
> Experience...led to...reduction in the lengths of the sides of the triangles. ... An average of 11 miles...has come to be recognized as the most suitable length...in the plains [6, 76][3].

On closing work in 1839 Armstrong left the scaffold standing at his last station hoping for an opportunity of finishing off the interrupted observations, but owing to "the severity of the...rainy season" he had to bring it in during August

> for protection against further injury, and for subsequent repairs. He experienced considerable difficulty...because of the state of the roads and the large number of carts required. ... The damage...took some time to repair which, with delays in obtaining carts, prevented...taking the field earlier than 25th December 1839[4].

Season 1839–40 was a very short one, and work confined to completing observations to the south. On 2nd March 1841, after completing a few observations near the Ganges, Armstrong was transferred to the Great Arc, handing over charge to Lane. The approximate series was extended "considerably to the northward of Almora", and was later absorbed into the Connecting Series [71]. Observations were taken up at the end of the year, but, writes Lane,

> in consequence of the extreme severity of the snow which was 5 to 6 feet high on the summit of Kankrakit...the northernmost station, ... I was induced to relinquish for the present all observations on the mountains, and march...via Almorah for...Mandabad, near Futtygurh, in order to complete the remaining vertical angles there, ... taking with me Mr.

---

[1] DDn. 379 (325-8), 11–4–37. [2] DDn. 378 (375), 26–4–37. [3] *GTS*. VII (xv–xvi—K). [4] ib. (xiii—K).

Sub-Assistant W. C. Rossenrode to co-operate in the simultaneous observations, and leaving Mr....J. Mulheran to determine the points...eastward to the Nepal frontiers, and after that to carry on a minor series...in the plains for...laying down the city of Rampore[1] [pl. 11].

During season 1842–3 Waugh resumed charge of the establishment which was employed as "the Pilibhit Terai series" on triangles connecting the heads of the Ranghir and Amua series [68, 71], and in October the party was re-formed as the Calcutta Meridional Series, and moved to Calcutta under Waugh's charge.

AMUA, 1833–9[2]

The Amua series is third in order from the west of the meridional chains running north from the Calcutta Longitudinal Series; and follows generally meridian 80° 30′. It passes through the hills of the Bundelkhand States of Panna and Chhatarpur, and the district of Banda, to the Jumna valley. It then crosses the *doāb* districts of Fatehpur and Cawnpore, and across the Ganges through Lucknow and central Oudh. Its northern triangles were later absorbed by the North-East Longitudinal series [pl. 11].

The party was raised by Renny at Agra in 1833. Leaving Agra on 30th November with two assistants[3], he reached his first station, a few miles north of Jubbulpore, on 13th January. Working north-east to avoid unfavourable ground to the immediate north, he sited one station on the Kaimur range, and then brought his series back to the ruling meridian. He completed observation of ten triangles, up to the northern limits of the hills near Banda, south of the Jumna. The clearing of rays through the plains aroused opposition

> until...the district officers were able to interfere. Further inconvenience was caused by the people...digging up and carrying away the mark-stones [60, 86]. Renny continued his operations into middle of June, when sickness broke out...in his camp, ... the rainy season having now commenced. ... Commending his last four stations to the care of the Collector of Banda, he turned...towards the recess quarters at Cawnpore, which he reached on the 1st of July[4].

Season 1834–5 was spent in laying out triangles by ray-trace across the plains and clearing the rays. After starting off the work, Renny handed over to Tulloh to join in the measurement of the base-line at Dehra Dūn. Resuming charge in June he found the party at work between Cawnpore and Lucknow.

> Operations had unfortunately been greatly retarded for want of...Government...support... in the necessary...cutting down all trees, and removing all obstacles, between the principal stations. Hitherto the district officers had generally been ready to aid the surveyors by giving the requisite instructions to the local native officials...to assist...in ascertaining the owners of the removed trees...and in estimating the proper amount of compensation. ...
>
> The Collector of Cawnpore...referred...to the Commissioner, ... by whom it was forwarded... to the Secretary in the Judicial Department. The reply was such as to paralyze, for a time, all vigorous prosecution of survey work. The Vice-President in Council ruled that "The officers of the Trigonometrical Survey are not authorized to remove trees or other property without the sanction of the owners previously obtained, and it will rest with those officers to offer such remuneration as will induce the owners to comply with their wishes". ...
>
> To lay out...at least ten new triangles...each field season, ... the clearing of at least twenty perfectly straight 14-mile lines was...necessary. ... To have raised the tower stations sufficiently high to overlook all intermediate obstacles would...have much retarded, and increased the cost of, the operations. ... Straight lines...could not be cleared without cutting down a considerable number of trees, ...and if this might not be done without obtaining the sanction of the owners in every instance, the operations...would have to be abandoned[5].

On the Surveyor General's representation it was ruled that district officials should accompany the surveyors to facilitate negotiations with the villagers [63] and armed with this authority Renny made good progress during season 1835–6, in spite of now having only one assistant[6]. Working with mud towers of twenty to thirty feet, he kept his expenses to a minimum [85].

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[1] DDn. 380 (387), 28–12–41. [2] TS. 9; G–6 3; *GTS Syn.* xvi. [3] Tulloh and Lane. [4] *GTS.* VII (iii–v—L). [5] ib. (vi—L). [6] Tulloh had resd. for a more lucrative appt.

By the end of the season rays had been cleared up to Sitāpur, and stations selected to the northern limits of Oudh, but permission to enter Nepāl was refused. Towards the end of the season the party was strengthened by the transfer of Murphy from the Great Arc, but progress was difficult through the notorious *tarai* forests ;

> I conducted a route-survey for the selection of points for principal stations up to the Nepal hills. ... Fever and other complaints prevalent in the Tarai broke out in my camp, and before I had returned to Sitapur both my sub-assistants were dangerously ill, and a great portion of my establishment laid up.
>
> As the dimness of the atmosphere...would have prevented me doing any more work until the commencement of the rains, and to detain my establishment in camp would only have been exposing them to relapses, I proceeded here [Cawnpore] as soon as my party was sufficiently convalescent. ... My sub-assistants are now out of danger, and the native establishment daily acquiring strength. ... Deaths from the tarai fever are confined to private servants[1].

At the beginning of season 1836–7 Renny started observation at stations near Cawnpore, but found visibility too poor for his long rays. Postponing further observation till after the first rains of the monsoon, he pushed on with the clearing of rays and building towers up to the northern limits of the series. On his being called away to the Sironj base-line in October 1837 [53–4], Murphy took charge and with Lane carried observations up to the Ganges.

> Murphy fell ill, and had to proceed to Cawnpore for three weeks, at the end of which...the favorable season...had ended. Crossing the Ganges into Oudh, he resumed work on the 21st December at the station of Rau, where he also took observations for fixing Christ's Church, Cawnpore, which was then being built. He waited there five days without being able to obtain complete measures of even a single horizontal angle, though he succeeded in taking simultaneous verticals with Mr. Lane on the ray to Jajmau. ...
>
> The winter rains had now set in, and the conditions became so unfavorable that though he remained at that station [Namana] from the 4th to the 28th of January, and worked whenever possible both day and night, he could only complete observations of two of the three horizontal angles[2].

Renny returned in March, and advanced towards Sitāpur, when he had once more to return to the Great Arc [42]. Murphy then went south to re-observe at a number of stations where, as Renny had pointed out, he had failed to change zero satisfactorily [90][3]. In October 1839 he resumed observations near Sitāpur and

> proceeded thence in succession to the several northern stations, the horizontal angles at which were all disposed of by the 9th of December. The prescribed azimuth was then undertaken. ... By the end of the month the whole of the programme...was completed, with the exception of the vertical observations. ...
>
> A collision occurred between the...native establishment and a large body of armed men in Oudh — who were said to be desperate freebooters, and inhabited a small fort of their own in a jungle on the banks of the Gumti... — which might have been attended with much loss of life, had not Mr. Murphy been at hand to interpose and protect his people. But otherwise the operations in Oudh seem to have met with no opposition[4].

The vertical angles were observed simultaneously, working along the diagonals only, "zigzagging from flank to flank". Field operations were concluded on the 2nd April 1840 and the party then marched in to Dehra to be broken up.

Pending sanction to the North-East Longitudinal series, the head of the Amua series was linked to that of Ranghir by the Pilibhit Terai series carried out by Waugh during season 1842–3 [67, 71].

KARARA, 1838–43[5]

The Karara series is fourth in order from the west of the meridional chains and follows generally the meridian of 81° 18′. It starts as a double chain of triangles through Rewah up to the Ganges west of Allahābād. The first 90 miles lie through hilly country, to cross the Kaimur Range. North of the Ganges the series is taken mostly by single triangles through the plains of Oudh to the *tarai* on the Nepāl border [13 ; pl. 11][1].

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[1] from Renny, DDn. 382 (189–90), 16–6–36. [2] *GTS*. VII (x, L). [3] DDn. 382 (273–5), 17–3–38.
[4] *GTS*. VII (xii, L). [5] *GTS Syn*. xvi ; TS. 10/1 ; GBO Comp. G. 5/13.

The party was raised at Sironj in January 1838 after the measurement of the base-line. Charge was entrusted to Jones, who had for several seasons been working on the Great Arc. With Scully as assistant, he reached Karara on 1st March. Unable to find suitable stations for a line of single triangles with sides not less than 20 miles, he obtained the Surveyor General's approval to work in double triangles with much shorter sides. By the middle of June he had selected five principal stations and when the rains began and sickness appeared in the camp, he took the party into quarters at Allahābād. They started out again on the 1st October 1838, but work had hardly begun before the whole camp was seized with jungle fever

> which compelled...return to Allahābād. Mr. Scully fell a victim to the disease and died on the 18th November. ... Jones himself and the entire...establishment were reduced to such a state of prostration as to leave the Surveyor General no alternative but to suspend operations[2].

Jones spent the rest of the season with the Surveyor General at Kaliāna [132], and was to have resumed work on the Karara series in October 1839. On the third march out from Dehra he was taken so seriously ill that he had to return, take sick leave, and eventually resign from the survey.

The series then remained in abeyance until 1st September 1841, when Shortrede was placed in charge. After inadequate preparation he took the field with two assistants[3] and reached Allahābād in December. His reports are not inspiring ;

> My camp left Dehra on the 11th, and arrived at Mirat about the 20th of October when, the pay office being shut on account of a native festival, I was detained till about the 26th when my camp marched towards Agra, where it arrived about the 8th of November. I halted there...in expectation of receiving with [your] countersignature the indents for office tent, and tent carriage, ... two commissaries having refused to comply...without countersignature.
>
> While at Agra I procured...some pieces of looking-glass which might serve to make up into heliotropes, the four supplied to me being...too few to enable me to make observations to more than two or three stations [87]. ...
>
> I arrived at Cawnpore about the 30th of November and—...detained for some days by heavy rain at Fattihpoor—...arrived at Allahabad on the 17th December. I there received a countersigned indent on the Delhi magazine for an office tent, which...was refused on the ground that I was now at Allahabad. It was...countersigned by the Major General Commanding at Allahabad, and the tent was at last received from the Allahabad magazine.
>
> On my arrival at Allahabad I set about making up trestles for lamps and heliotropes. ... I made up also a number of hatchets for cutting jungle. ... These occasioned no delay as the hatchets were ready before the trestles. ... I did not stay to make up sight vanes though such would have been very desirable, but proceeded towards Rewa on the 26th of January.
>
> Having no introduction to secure my being recognized by the Government of Rewa...I took the liberty to address the Governor General's Agent at Jabbalpoor, requesting him to make the necessary communication. ... The Rewa Government has sent...two harkaras...for the supply of provisions—...apparently considers the work...on a par with...the Revenue Survey—...I am...proceeding as well as I can.
>
> The...jungle to be cut to clear the rays...is very great. ... The platform at Dadar...was entirely pulled down to the lower mark, and the stones scattered. Perhaps you may be able to devise some means to prevent such dilapidations for the future[4] [86].

He was still at one of the base stations five weeks later ;

> I have been here for the last fortnight, but have not been able to get a single observation. I have not been able to use the heliotrope at Karara or at Rewa, nor have the parties there been able to see mine. I have tried heliotropes and fires, single and double, but without effect. The invariable report is that they cannot be seen. On one evening I thought I saw both lamps, but before I had time to make sure...they disappeared. ... To ensure the correct pointing of the lamps and heliotropes towards me...the Babu is now at Karara, and also a hand telescope has been sent to each station to assist them, ... but as yet all without success.
>
> A few days ago...the hill on which I am encamped caught fire. My own tent being nearest the fire, I had just time to strike it, and get it hauled away about 30 yards, and by that time the fire had advanced to where it had stood.

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[1] MRIO. 95 (4) ; ¼-inch map of country E. & W. of Karara Series ; SGO. 1839. [2] *GTS.* VII (iii–iv, M). [3] Ram Dial De and Kirwan [81]. [4] Shortrede to SG., DDn. 377 (189–91), 9–2–42.

> I got the office tent also struck, and removed to the place of greatest safety. ... While this was being done, I was busy directing arrangements to save the instruments and observatory tent. There was no time to remove the tent but...I determined on removing the instrument, which was done without damage further than a little scorching to myself and those employed. I...put all the strength I could muster to extinguish it [the fire], where from the scantiness of the grass...it could be approached sufficiently near. After about 3 hours work the fire was fairly driven from the neighbourhood of the station, and as the grass around is either all burnt, or has no communication with that elsewhere, I feel tolerably secure against the recurrence of the like.
>
> The worst effect of it is that the atmosphere has become very murky, and unless we have a storm or a shower of rain I fear I shall be unable to do anything. The sun becomes invisible at about 1½° above the horizon, so that I have very little hope from heliotropes, and the lamps seem insufficient to penetrate the gloom[1].

Such forest fires are of frequent occurrence in all wooded parts of India and Burma, especially during March and April, and the consequent smoke, added to the dust, always makes March a particularly difficult month for triangulators [III, 76, 184]. Everest thought that Shortrede should have taken better precautions ;

> It is by no means an uncommon occurrance for the dry grass at the tops of the hill stations to take fire, and the only remedy against mischief...is to burn up the grass before pitching up the tents, or placing the instrument in position. This is a necessary precaution, and if... people...be assembled, each armed with a green bough to keep the fire under control, the operation is easily effected, ... when the camp may be established out of reach of harm.
>
> If any loss had occurred to the public property, ... Government would have called on you to make it good. ... A gentleman of your experience would...be expected to be on the alert. ... I judge...that no injury has been done save the loss of the paper of instructions and a reading glass. ... I can replace the former...but I must beg...you to replace the latter[2].

Finding that visibility showed no signs of improvement, "and with a sick list continually increasing", Shortrede gave up his reconnaissance, and beat a retreat to Allahābād, where he arrived about 27th April—after little more than two months field work—with practically nothing accomplished. Everest was not pleased.

In the following field season, 1842-3, the party,

> strengthened by...Armstrong who had acquired considerable experience...on the Ranghir series, left Allahabad on the 15th of November 1842, and made such good progress that by the end of the field season all the stations south of the Jumna had been selected, and the principal observations...completed for a distance of about 65 miles. ...
>
> The general design of the triangulation...consisted of continuous net-work of triangles, in which mutual observations were taken between all stations, instead of forming a succession of simple polygonal figures in which the mutual observations are restricted to the stations lying contiguous. ... Theoretically, of course, the net-work is the best, ... but practically it is far the most troublesome. ... It is, moreover, very variable in its influence, tending to strengthen some portion of the net-work more than others. For these reasons it had been deliberately rejected by Colonel Everest in favour of the simpler system[3] [60–1].

The party returned to Allahābād on 2nd June. When on 27th October Everest touched there on his final journey down the river [174], he was surprised to find it still in cantonments, but Shortrede admitted no blame ; he knew of no rule fixing a date for taking the field and, if he had, would consider it as one to be

> obeyed rather in its spirit than in its letter. Your letter of instructions to my predecessor contains the injunction that the first of all considerations is that of the health of the party. ... He lost a sub-assistant and several of the native establishment, and had a narrow escape with his own life [69]. ... On my first season, though I entered that country [Rewah] when it was considered to be quite safe, ... six died during the three months I was in the field, and...I was obliged to return to Allahabad having twenty of my party on the sick list. Last year, ... without incurring any blame from you, I took the field...about the middle of November[4].

Noting that "the Karara series superintended by Captain Shortrede appears...to have languished under that officer's management", Everest obtained approval for Du Vernet's party to work southward from the foot of the hills. The two parties closed their junction in May 1845[5] [71].

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[1] DDn. 375 (475–9), 11–3–42. [2] DDn. 377, Everest's reply, 3–5–42 to Shortrede's official report of 9–4–42. [3] *GTS.* VII (v–vi, L). [4] reply, 27–11–43, to Everest's note of 13–11–43 ; DDn. 520 (24), & 435 (113). [5] *GTS Syn.* xvi ; TS. 10/1 ; *IO Cat.* (17–9).

In August 1839 Everest pointed out that it was essential for the satisfactory closing of the several meridional series, either to measure a special base-line at the northern end of each, or preferably to carry a longitudinal chain of triangles along the base of the mountains [18–20]. As the best line would pass through forbidden Nepāl he obtained approval to run a series as far east as possible without infringing the frontier[1]. On Du Vernet becoming available in September 1841 he was given charge of a special party to work eastward from the Great Arc side Banog–Dhoiwala [pl. 4], and to connect named sides of the Budhon and Ranghir Series.

With two assistants[2] he first worked too far into the hills, taking stations of nearly ten thousand feet, and being much interrupted by snow. Under directions from the Surveyor General he shifted the line further south to connect with the Budhon and Ranghir series, the latter of which had been extended by Lane to the north of Almora. Nepāl blocked further progress to the east. To Everest's complaint of his slow progress Du Vernet replied that in addition to laying out his "grand triangles" he had in part completed a secondary triangulation

> over the same ground for determining the positions of the principal towns and peaks. ... This was your most particular order verbally given me on more than one occasion, ... though at an after period I...found so great labour was accounted by you as no part of my work. ...
>
> I also measured the final angles at...Banog, Dhoiwala, and Chandial. ... But the weather during the late part of the season was very unfavourable, and at the several stations I was detained from 20 to 25 days for work which at a more favourable season would not have kept me more than two or three days. At the station of Chandi–pahar, after waiting nine days, ... and my party falling sick, I was obliged to return without effecting anything, never having been able to see more than six or seven miles. ... The plan of triangles...shows...13 grand triangles selected by me during the season, in addition to the numerous secondary triangles. ...
>
> The work...was of a very difficult nature. I had to form a series connecting three bases given in position, and to have no angles less than 30° or greater than 90° [76]. These restrictions rendered the work most difficult, and I was obliged to traverse the country in every direction before I could effect it. I have great experience in operations of the kind [256]. ...
>
> The country...could in most directions only be crossed on foot by narrow mountain paths. It took me from 3 to 4 days to make a direct distance...of from 15 to 20 miles. I generally marched from about 9 a.m. to 5 p.m. In the plains a side of a triangle can commonly be traversed in one day. After November the higher hills were inaccessible, being covered with snow, and the frost severe. ... The men suffered severely from it. After March the atmosphere was very obscure[3]. More than two or three clear days did not happen in the month. ...
>
> Previous to...my final work, I had to make heliotropes and sight vanes [66, 87]. ... Of lamps I had but three, and the use of stoves is not allowed. It takes time to get these things ready. ... My assistant did not join me until October, and then I had to get the whole of my extra carriers at the mountain. The Hon'ble the Lieutenant Governor was on the hill, and for whose use every cooly that could be hired was taken up[4].

The connection was completed during the second season, Du Vernet having "constructed about 300 secondary triangles, ... determining...the exact position of numerous peaks of the Himalayas and their altitudes, and of the chief towns"[5].

During the same season, 1842–3, Waugh connected the heads of the Ranghir and Amua series through the low-lying *tarai* by means of eleven towers, his triangles being known as "the North Connecting Series in the Pilibhit Terai" [67], whereas Du Vernet's was described as that in "the Sub-Himalayan Range"[6]. Both parties were inspected by Everest during January and February 1843 [64, 320].

The following season, Du Vernet ran a series of single triangles eastward from the head of the Amua series to the meridian of Karara, and then started southwards along that meridian to meet Shortrede [70].

These short connecting series were only a temporary expedient, and some years later were superseded by the North-East Longitudinal Series which ran more than ten degrees from the Great Arc to the Calcutta Meridional Series without infringing Nepāl territory[7].

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[1] BMC. 25–3–40 (14). [2] Nicolson & Boyne. [3] the regular dust haze [III, 52]. [4] Dehra Doon, 5–8–42 ; DDn. 435 (112–9). [5] ib. (214) 5–5–43. [6] DDn. 452 (120), 1–5–44. [7] *GTS Syn.* xxxv (iv, 41); TS. 9 (2, 4, 5); 10 (2).

SHORTREDE'S TRIANGULATION, BOMBAY[1], 1830–5

Everest's longitudinal series of 1822–3 had been broken off abruptly on the borders of Sholāpur [III, 234–6 ; pl.18], and Jopp and Jervis had based their triangulation on Garling's triangles along the borders of Goa and Hyderābād [II, 215–6 ; pl. 16 ; III, 129–30]. In 1828 it was decided to start a better class of triangulation to control all Bombay surveys, and this was entrusted to Shortrede who measured a base-line at Karli near Poona [III, 130 ; IV, 56–7], from which to extend a net-work of triangles over the northern Deccan [III, 130–1].

> The remainder of the fair season of 1829 was employed in...connecting the Bombay lighthouse with the work of the late Captain Garling. Next season 1829–30 the triangulation was carried through part of the Northern Konkan as high as lat. 19° 30′, and through part of the Dekhan to...near Ahmednagar. In 1830–31 the triangulation was carried on in the Konkan. ... In the season 1831–32 the triangulation of the Gangthari was completed, and the work carried on through the jungly part of the Konkan west of Khandesh, till I fell sick[2].

Though the Directors had in May 1830 agreed that Shortrede should work under the general instructions of the Surveyor General this was not arranged till Everest made special application in March 1831[3]. He made exhaustive enquiries about the work, and though Shortrede satisfied him generally regarding the base measurement at Karli [56–7], he found the whole system of triangulation too slovenly for incorporation with the work of the Great Trigonometrical Survey.

He criticised the faulty "observing and registering of angles. ... The theodolite did not admit of a change of zero, and all the angles were...observed on one portion of the instrument". There was no assurance that the opaque signals used were vertically over the station marks. Triangles were arranged in a haphazard net-work, and computed with no systematic design. Everest ordered that a longitudinal series should be extended from his own series of 1822–3.

Shortrede made some attempt to comply with instructions, "but the improvement effected was small"[4]. In November 1833 he sent in a chart of his "triangles from the beginning of my work. ... arranged in the manner directed".

> Last season I furnished to Captain Jopp a number of points for...the survey of the Northern Konkan, and can do the same as for the...detail survey this year on the border of Khandesh but, as I shall be ..completing the connection to the eastward, it will not be in my power to continue my work in advance of the detail survey beyond the present season [240].
>
> I would...suggest...my having...an assistant. ... I have...been obliged to go on as well as I could by myself, and hitherto I have been able to keep ahead of the detail survey, but such is not likely to be the case in future. ... In the event of my falling sick temporarily, as happened for the last two seasons, or if I should be obliged to go away for the recovery of my health, ... the whole of my work must stop. ... There is here a young officer of Engineers, Lieut. Jacob, ... perfectly qualified for every part of the work[5].

Jacob was appointed assistant from 14th January 1834, and in July Shortrede reported that he had laid out connection with Everest's work near Sholāpur.

> The accompanying chart shows the extent of country triangulated. ... These points have been pretty well intersected, and will hereafter be principal stations for extending the work through Khandesh[6]. ... Night lights were tried...but without success. ... The triangles are of gigantic dimensions, yet the points are distinctly visible by daylight in a clear weather. Purandhar Pagoda is visible from Kanheri at a distance of 115½ miles. ... A series of equally extensive triangles can be carried throughout Khandesh to the Satpura range[7].

Everest was still shocked at the magnitude of Shortrede's triangular errors, and asked him to re-observe some of the worst triangles, and to arrange his work as a systematic grid. Regarding his own series of 1822–3 ;

> I...was obliged to leave...without finishing my observations at Chorakali to the western points [III, pl. 18]. If I had been aware of the magnificent country in prospect I should probably have made an attempt to improve the triangles so as to connect them symmetrically with the grand points to the westward.

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[1] *GTS. Syn.* xxvi. [2] Triangles shown on map of Khāndesh, DDn. 127 (6) ; DDn. 324 (100–10), 4–7–34. [3] CD to B., Mil. 26–5–30 (5) ; SG. to Mil. Dept. 10–1–31 ; DSG. to Shortrede, 22–2–31. [4] *GTS. Syn.* xxvi. (iv-v, —B) ; *GTS.* XII (4). [5] DDn. 324 (79–87), 7–11–33. [6] chart MRIO. 127 (6). [7] DDn. 324 (109–10), 4–7–34.

> It will be in conformity with the wish of the Court of Directors, as soon as this connection is formed, to fix on certain points of your series for independent meridians to start from. The meridians should be about 60 miles [apart] longitudinally...and the azimuths should be observed at each. ... As soon as Lieutenant Jacob has had practice enough to qualify him fully to use one of the large instruments, I shall recommend to the Bengal Government to place him in charge of an independent series under my orders. ... It is not the usage to employ more than one officer on any series [358–9][1] .

Shortrede did not reply till nine months later. He and most of his staff had been diverted to revenue survey duties under the local Government [236, 366], and though he still retained nominal charge of the trigonometrical survey, it was Jacob who did the work. Since September 1834 Shortrede had been employed

> examining a revenue survey of the Dekhan [9, 236]. ... That duty being not yet completed, it has been out of my power to reply satisfactorily. ...
>
> The estimation of the amount of error in the triangles...arose from my having given this part of the work into the hands of the clerk. ... I had not myself time to go over the arithmetical additions and subtractions by which the tabular amount of error was deduced. ...
>
> Part of the errors are due to the extreme indistinctness of some of the points at the time of observation. The observations were all taken by daylight, and except a short time of the year it is extremely difficult, if not impossible, to get the distant points to be seen clearly. ...
>
> Lieutenant Jacob has been engaged during last season in repeating the observations at those stations where they were of most importance. ... When...[he] was at Dharur, the instrument, stand and all, was blown down by a hurricane, but I have succeeded in adjusting it[2].

Three months later he submitted his half-year's report ;

> Neither myself nor any of the sub-assistants have been engaged directly on Trigonometrical duties[3], ... and the special duty entrusted to me is likely to require that for some months more we should be employed in this separate work.
>
> I...enclose you the observations made by Lieut. Jacob determining the azimuth at Mandvi and Karanja stations. ... To make these observations at Bombay lighthouse, an attempt was made, ... but the top of the lighthouse and the roof of the observatory [III, 102] were both so unsteady that observations could not be made from them. ...
>
> I suggest that Lieut. Jacob be appointed to take charge of the survey during the time I may still be employed on these special duties, as I find it quite impossible to carry on satisfactorily the duties of the survey together with the other[4].

Everest was far from satisfied, and reported that Shortrede's work

> was...found to abound with errors of such magnitude as to render it unworthy of confidence. A list of the most glaring of these errors was made out, and forwarded to Lieut. S., from whom no adequate explanation...has been received as yet, and as he has been employed since Sept. 1834 on a duty quite foreign to that of his own proper avocations—by order of the Bombay Government—it is not easy to say when he will be able to account satisfactorily for the great discrepancies...that have been pointed out to him. ...
>
> Without a personal visit of the Surveyor General...to inspect the operations carried on at Bombay, they will never be reduced to method or accuracy. ... The removal of Lieut. Shortrede was a measure in which the Surveyor General was not consulted[5].

It was not until he had spent nearly two years on local revenue surveys that Shortrede resigned his appointment in the Trigonometrical Survey for which he had been steadily drawing his salary[6].

BOMBAY LONGITUDINAL SERIES[7] ; 1836–42

During the next two seasons, 1835–7, Jacob closely followed Everest's instructions, completing connection with the old series of 1822–3, and re-observing several of Shortrede's triangles. In the latter part of 1836 he joined the Surveyor General's camp at Sironj for several months, and watched the great master at work [40].

On his return to Bombay in March 1837, he represented the needs of his survey to the local government and, supported by the Surveyor General, was granted an establishment similar to that of the Bengal parties. He spent the rains in training his men, more especially in the use of the heliotrope, of which he had a number made up locally, pending the arrival of others from Calcutta.

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[1] DDn. 381 (269–73), 25–8–34. [2] DDn. 324 (123–5), 9–5–35. [3] Fraser, Price, & Sanger posted in Feb. 1835 from former office of DSG. [383]. [4] ib. (127–8), 15–8–35. [5] DDn. 286 (228–35), 31–10–35. [6] DDn. 518 (14), 1–9–36. [7] *GTS Syn.* XXVI ; TS. 8, pt. 2, with skeleton chart ; GBO Comp. G. 5/11 ; *IO Cat.* (15).

During season 1837–8 he re-observed all the triangles between Sholāpur and Satāra and, but for unseasonable rain during November, would probably have completed the series to the coast[1]. This was, however, completed during season 1838–9 by Shortrede, who was called in during Jacob's sick-leave to the Cape. Shortrede now fixed the positions of the light-house and observatory at Colaba[2] [III, 192], and observed several azimuths, but the triangulation could not be taken as final until the re-observation of Everest's series right back to Bīdar[3]. He therefore worked on computations till Jacob rejoined at Bombay on the 13th May 1840,

> and resumed charge...from Captain Shortrede on 23rd. I then found that no field work had been done during the preceding year [1839–40], but that the office was engaged in the calculation of the latitudes and longitudes. ... I continued these...for some time, until I found that they could be considered only approximate. ... The remeasurement of the eastern part of the series and, in particular, of the Bedar base [17, 55] would probably...alter the whole calculations. ... The azimuths...which had been observed during my absence were very discrepant, and...did not appear to have been made with sufficient care. ...
>
> On 19th October, being the first day that the weather would permit, the establishment left Poona for the eastward, for...repeating the angles...from Dharur to Damargida...and reached Dharur on the 3rd, when both the upper marks...were found to have been removed, nor could any other be found on searching to a depth of 3 or 4 feet, but in the centre of the platform was found a hole filled with mud into which a stick could be thrust to a considerable depth. ... I thought it better to put up a new mark, and repeat all the observations. ...
>
> In order to prevent...a similar accident, I set up a mark on the largest stone which could be brought to the spot ...being about 3 feet in height and weighing 6 cwt.—and then proceeded with the observations. ... On arriving at Garh Daud, the platform was there also found to have received much injury, but the mark was apparently undisturbed. ... I repeated all the angles... when their agreement showed that no sensible derangement had taken place.
>
> On the 16th December, I received a letter from Lieut. Waugh, in consequence of which I proceeded to Dumargeda to communicate with him on the connection...with the Great Arc, when it was agreed...that he should observe the angles connected with Munganal...and that I should finish the remainder [III, pl. 18 ; IV, 53]. After completing this...I returned to the neighbourhood of Poona, and employed myself in laying out...a base-line a few miles west of Poona, in a spot which I had noticed the year before[4] [57].

After the rains of 1841 Jacob took his party down to Bīdar to assist in the measurement of the new base-line there[5] [53]. During his absence he left Sanger to select stations for a meridional series, South Konkan, to run southwards down the west coast from Bombay to Vengurla. On his return from Bīdar he started observations on this line, but owing to the haziness of the weather did not get further than Mahābaleshwar[6] ; at Mandri H.S. the mark had been destroyed and every stone rolled down the hill. The series was completed during season 1843–4.

Being anxious about his health, Jacob now obtained the services of an assistant, Harry Rivers of the Engineers[7], and after the rains of 1842 employed him on connecting the Karli base-line with the longitudinal series. He then

> directed him to proceed with the triangulation of the North Konkan. ... I have hitherto kept him in the neighbourhood of Poona, in order to give him as much practical instruction as possible, by which he has profited so much that I have little doubt of even his first season's work proving satisfactory. ... The triangulation connects the base measured by Captain Shortrede with the principal triangles of the Bombay Longitudinal Series. ... The error on the Karli base is now reduced to 1·10 inches, or 0·28 inch per mile[8].

Jacob was now free to hand over to Rivers, and once more went on sick leave, but this time not to return. Everest thought very highly of his work, and in comparing the Bombay with the two other longitudinal series — Madras to Mangalore by Lambton — and Sironj to Calcutta by Olliver — he considered the series by

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[1] DDn. 518 (80) Aug. 1838. [2] taking off the roof of the observatory [73]. [3] Everest distrusted the results from the old 36-inch theodolite [III, 258 ; IV, 15–6]. [4] DDn. 518 (149), 7–7–41 ; during 1862–3, the longil ; series Gt. Arc to head of Mangalore Merdil. nr. Ahmednagar was remodelled by Haig as series of polygons, *GTS*. XII (viii–ix, B). [5] left Poona 4–10–41. [6] TS. 14/1 ; *IO Cat.* (22) ; *GTS. Syn.* xxvi ; TS. 8 (also Comp. Q–1–13). [7] joined at Poona 9–6–42. [8] DDn. 518 (215–6), 14/23–12–42.

> Lieutenant Jacob...by far the best. That officer is an excellent observer, and distinguished for his facility of applying what he knows, which is of a high order, and of no small extent[1].

After Jacob's departure, Rivers started the North Konkan series, later known as the Singhi Meridional. Starting from the side Karanja–Singi[2] of the longitudinal series, he carried a series of single triangles northwards along the coast, till stopped by thick smoke haze [39, 70]. He reached Parnera[3] in February

> without difficulty or interruption. Smoke now began to rise from all the neighbouring jungles, and several days passed without a heliotrope being visible [60]. Finding that the smoke became daily denser, and that the haze and fog from the sea seemed to be gradually increasing, Rivers quitted Parnera after a halt of three weeks without finishing his observations.
>
> As the season was now well advanced, he thought it better to proceed to...the...Ghats, which he hoped were at too high an altitude to be affected. ... But...not only was the heliotrope at Surat completely obscured by the smoke and haze on the plains, but even the few hill stations that were mutually visible were...foggy and indistinct. ...
>
> At his last hill station of Paura all the heliotropes were visible except the one at Parnera, which lay in the thickest part of the smoke. It was useless to continue...and so towards the end of March Rivers set out for Poona. ... Two...sub-assistants, the hospital-assistant, and 20 men, were all down with fever at Parnera, and at Paura Rivers himself succumbed[4].

He was to struggle against similar conditions for several seasons, but proved a capable and resourceful surveyor, and held charge of the Bombay party with success for the next ten years.

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[1] Everest (140–2).

[2] 10 m. SE. of Bombay.

[3] 10 m. SE. of Damān.

[4] *GTS.* XIV ; *GTS. Syn.* XXXII (vi–vii, H).

CHAPTER VI

PRINCIPAL TRIANGULATION : PRACTICAL DETAILS

Lay-out & Reconnaissance — Ray-traces — Towers — Station Marks & Platforms — Signals — Horizontal Angles — Vertical Angles & Heights.

NO triangulator of to-day, even with the best of maps, would venture to start observations without a preliminary reconnaissance of his ground, except of course when this was prevented by military restrictions.

Mackenzie advised his assistants on the Mysore survey to start by making themselves "sufficiently acquainted with the face of the country" [II, 210], but frequently himself got into difficulties by failing to select his stations well in advance [II, 206–9]. Lambton fully realized the absolute necessity for careful reconnaissance, and it was for this purpose that he obtained the services of Warren and Kater as assistants. Whilst awaiting the arrival of his great theodolite before they joined he "made an excursion down the coast as far as Pondicherry with a view to examine the country, and choose the stations best adapted" [II, 237].

Everest made no such preliminary reconnaissance on his first excursion in 1819 but contented himself with sending forward his flagmen, and sometimes a sub-assistant, to mark the forward stations [III, 230–1]. On his later expedition towards Poona, he found he had to spend much time in the selection of forward stations, one triangle at a time, to ensure that they would be mutually intervisible [III, 234–6]. On his extension of the Great Arc towards the north, he sent Rossenrode forward to lay out an "approximate series" of triangles through Bhopāl, whilst he went forward himself to measure his base at Sironj, returning later to observe at the stations which Rossenrode had selected [III, 245–6].

In the long chain of triangles to Calcutta, Olliver followed this example and kept Rossenrode in advance to select forward stations and take preliminary angles with a small theodolite to fix their approximate positions. Rossenrode's work became increasingly important when the series reached the Bengal plains, where he had to search for elevated spots that would provide sites for mutually intervisible mounds or towers and give well-shaped triangles [III, 261–4].

It was a standing rule—that Everest would never allow to be broken—that no triangle should contain an angle less than 30° or greater than 90° ; the nearer each angle was to 60 degrees the better was he pleased [71].

Lambton had not followed any definite lay-out for his main series, whether meridional or longitudinal. His triangles were arranged singly, or in quadrilaterals or polygons, as happened to be convenient. He did not bind either himself or his assistants by rigid rules. On the other hand his main triangles were not thrown over the country in a haphazard net as has been suggested. He ran chains of principal or secondary triangles roughly along meridians or parallels, or parallel to the coast, and filled the intervening spaces with a network of triangles for the assistance of future surveys [II, 241–8].

Southern India provides excellent opportunities for long-sided triangles, of which Lambton took full advantage, some of his rays on the Madras-Mangalore series being over 60 miles long. Everest also appreciated the advantage of large triangles, but as a general rule favoured sides of from twenty to thirty miles[1]. It was not till after his assistants had experienced exasperating delays in trying to cross the Jumna-Ganges plain with such large triangles that he directed them to drop the sides to 10 or 15 miles [6, 84].

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[1] along Gt. Arc north of Sironj, 5 sides over 30 miles.

For their simplicity of observation and computation Everest preferred chains of single symmetrical triangles, as nearly equilateral as possible. When important chains were doubled, polygons were preferred to quadrilaterals in which the long diagonal was often difficult to observe and equilateral triangles unobtainable[1].

For the Parasnāth series [59–60] he advised Western that

> the stations which you chuse should generally be on the highest points, but as these are sometimes inaccessible, it may be necessary to adopt a lower point. ... The view should be unobstructed on all sides. ... Care must be taken that on neither side is the ray obstructed from any higher point which may eventually...form the site of a principal station.
>
> Your first business on arriving at a principal station...is to put up the instrument. ... Having adjusted it, you will find out the direction in which you would wish the stations in advance to lie, and by means of the level you will judge what points...are likely to be visible from each other, and from the stations with which they are to be connected. ...
>
> You will, in dubious cases, ... select more than one point for each station in advance, and ...detach a flag for every principal station with two flag coolies. [A survey flag was to be hoisted on the most likely point chosen, and a pole and broom at any other]. Some days will perhaps elapse before you hear...of the parties so detached, and the first intelligence...will generally be through the double fires which...the flag coolies...burn [27]. ...
>
> It not unfrequently happens that the people who go to choose a station select a wrong place ; in that case, if there is obvious neglect, it is usual to make the defaulter pay a fine. If on the contrary...the man has done his utmost, there is no remedy save patience, and sending another person. ... Where a station of difficulty is selected with great cleverness, it is always usual to present the party with a rupee, and charge that to the contingent account[2].

Everest insisted on the importance of siting stations to the best advantage.

> The entire responsibility of their eligibility rests with the person who conducts the series. ... Much depends on the efficiency of the subordinates and the confidence which they place in their superior. By constant care, patience, regularity of system, and good temper, natives may be trained to...execute it ably under very difficult circumstances, but the...unskilfulness of a subordinate will never be received as an excuse for a badly selected station [III, 308][3].

The reconnaissance for the northern section of the Great Arc was a major operation. Existing maps shewed little beyond the general lie of the country ; they were of no value for the selection of stations, or even of the line to be followed [15]. After Boileau's failure the southern portion through the hilly country was left to Rossenrode's experience, though some of his northern stations had later to be shifted, but for the line across the Jumna-Ganges plain Everest soon realised that the task required his whole personal attention [23 5].

He spent four months working up from the hills of Bharatpur to the Siwāliks, building up his triangles with the help of lofty masts and scaffolds, carried round from one point to another. His first efforts were not very satisfactory.

> Considerable delay and expense were incurred in carrying about the masts, bamboos, ropes, and other materials required for the scaffoldings. ... The blue lights...were liable to burn out before the theodolite could be set on them. Frequently they were invisible to the naked eye, and had to be sought by the telescope, ... but in the absence of a fairly approximate knowledge of their direction they could not always be found. Thus it was often uncertain whether the blue light was hid out by intervening obstacles, or whether it might have been seen had it been looked for in the proper direction [35–6].
>
> These circumstances eventually led to...a method of feeling the ground step by step, and learning all about the obstacles on it, rather than endeavouring —often very vainly—to look over these obstacles. This is Colonel Everest's system of ray tracing. It consists in carrying a minor triangulation, or a traverse, between two mutually invisible points, which enables the relative direction...to be ascertained with sufficient accuracy to permit of a straight line being carried between them. All the obstacles...can then be discovered, and must be removed if possible, failing which the position of one or both of the points must be altered [36, 78].
>
> The system is vastly superior in rapidity of execution, and in generally curtailing labor and expense, to that which was first tried[4].

The laying out of the several subordinate chains of triangles across these thickly populated tree-covered plains was indeed a matter of such great difficulty that in many cases the reconnaissance alone occupied one or more seasons, for in addition to the selection and laying down of the stations, generally by ray-trace, there followed the clearing of lines, the observing of an "approximate series" for fixing exact positions of mutually intervisible stations, and finally the building of towers or station platforms. The stations from which final observations were made were often different from those that had been first selected [31, 77].

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[1] De Graaff Hunter, 1955, fully agrees. [2] DDn. 267 (104–13), 6–2–32. [3] DDn. 431 (263–9), 10–9–13. [4] account by General Walker, *GTS*. II (41).

RAY-TRACES

Ray-traces were used to ascertain the bearing of a distant point whose position was not exactly known, and that was invisible from the station of observation. To lay out his triangles across the flat tree-covered plain, Everest had several assistants well forward selecting advance stations. In some cases there might be an obvious point that would make a well-shaped triangle with the stations to the rear; in other cases there might be two or three such likely points. But if trees or buildings intervened it was impossible to decide straightaway what points would best connect, both with the rear stations, and with those to be sited further ahead. Stations had to be selected by trial and error, and each tested for intervisibility with neighbouring stations all round the compass.

To gain such visibility in the first place Everest tried working with his instrument perched on a 30-foot mast. His assistants at the forward stations had formidable apparatus by which they could display blue lights at a height of up to 90 feet above the ground. But without visibility it was impossible to tell the exact mutual bearings between observer and signaller. The observer had to search his horizon within certain bearings in the hope that he might catch sight of blue lights that were burnt at short intervals, and with the fear that they might either be obscured by thickness of the atmosphere, or by some physical obstacle.

After repeated disappointment Everest resorted to the running of a series of short-sided triangles from his station of observation in the general direction of his forward point until connection was actually made. The exact bearing could then be calculated, and the actual ray cleared of intervening obstacles. The observation of these small triangles took much time, until it was proved that perambulator traverse would serve the purpose with sufficient accuracy, and much greater speed[1]. General Walker describes three methods of ray tracings,

> first by a minor triangulation without any linear measurement; secondly by a traverse... [with] both linear and angular measurements; ... and thirdly by a simple alignment of flags.
>
> The first method is much the most accurate, but it is also the most laborious; moreover the surveyor is...frequently compelled to zigzag about in order to avail himself of natural openings for the lines between his stations; he is then not able to feel the ground very closely, ... thus a trial line has to be carried over the ray...to ascertain with certainty whether it is practicable. ... As direction only is required, any hypothetical value of the base from which the triangulation is started will suffice. ... The determination of the true length...was postponed until after that of the ray was obtained, and then the position of all the stations of the minor triangulation were computed for the purposes of local surveyors. ...
>
> The second method is less accurate, but is much...less laborious. A traverse is carried with a theodolite and a perambulator...approximating as closely as possible to...the ray, and care is taken, whenever intervening obstacles necessitate a divergence from the line, to return to it as soon...as possible. Thus the ground can be closely felt and examined. ...
>
> In very intricate country—where the chances of the lines falling on the temples, mosques, mausoleums, and other permanent buildings, or on noble trees which it would be a sin to cut down, are very considerable—this method is decidedly the best, from the opportunities it affords of thoroughly examining the ground, ... and of ascertaining the extent to which the trial line should be shifted to the right or left, in order to avoid all obstacles which cannot be removed.
>
> [The method by alignment of flags was not adopted by Everest or his assistants].
>
> The trial line forms an essential part of each of the three processes. ... Whenever irremovable obstructions are met with, ... the points where they occur are noted, but the line continued.

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[1] *Meridional Arc* (xix–xxiii).

> ... Thus data are furnished for calculating the direction of another line avoiding all the obstacles, and this is usually marked out by proportional measurements from the first one. Then the final line is widened to a breadth...of about 50 feet. ... Care is taken to remove all branches of trees and other objects...which...might...cause lateral refraction.
>
> In most parts of India it is, as a rule, far more economical to remove the obstacles on the lines, than to build stations of sufficient height to overlook them. Permanent buildings and noble trees are usually not so plentiful but that they may be easily avoided, ... and the simple huts in which the mass of the population delight to dwell may be easily removed. ... They are of so little value that a present of a few rupees speedily reconciles their owners to pulling them down and rebuilding them a few yards off. The difficulties and expenses of line clearing... are most formidable in the vicinity of the great cities and towns[1].

Everest first tried out this ray-tracing himself on the Great Arc [31–2] ;

> Dholri...station is on a slightly elevated land. ... The tower...is 50 feet high. Great difficulty occurred in fixing this position...because...the country was so thickly studded with trees—some of them very lofty—as to limit the view to a very short distance.
>
> The first ray...was obstructed by a large tree within the village of Dholri, between the branches of which the blue lights...appeared on the afternoon of the 5th March 1834. That tree was felled on the succeeding day, and the ray was half cleared before I quitted the station, the remaining clearance having been left to...the final work. The ray passed free of all villages and ultimately the heliotrope was visible all day long.
>
> The next ray, viz., Dholri to Saini, is chiefly remarkable as being the first instance in which... tracing rays was brought into practical application. It was found that blue lights burned at Saini were not seen from Dholri, which I first attributed to the murky state of the atmosphere, but subsequently...it became manifest that some object impeded the passage of the ray. Amid so many trees it was impossible to divine which was the one obstructing, and there was no method then in use of determining the point in doubt, except that of carrying on a minor series of triangles and resolving the sides, one by one, into two rectangular coordinates by projection on the first side. This had been previously tried...but...was so tardy a process that some more expeditious method was...highly desirable.

Everest then describes his method of running a blind traverse from a known station to a distant station, plotting that traverse, and calculating the perpendicular distance that each intermediate station will lie from the ray to be sought.

> The true course of the ray, Dholri to Saini, having by this means become known to within a short distance of the truth, the cause of the obstruction was immediately discovered, a high pipal tree about 3 miles off stood directly in the way, which having been forthwith felled the observations were completed after the following midnight[2] [36].

With Boileau's assistance Everest so simplified this traverse method that the assistant running the trace required no abstruse mathematics, and the required bearing could be deduced in the shortest possible time. The following is an extract from a circular sent out to officers in charge of independent parties ;

> The sites of the towers will be selected merely by tracing the rays. All that will be necessary in selecting the stations is—1st. That they be situated symmetrically—2nd. That no high object which cannot be removed should stand between any two sites.
>
> When by tracing the ray you know how the proposed station...lies from the station...at which you are, you may...cut such of the intervening trees as...to satisfy yourself as to the practicability of the ray. But, as the inhabitants are averse to part with their trees, it is desirable that you spare them as much as possible [150–60]. ...
>
> I recommend your using a perambulator and the best small theodolite you have in taking the angles, which should be observed with the utmost precision ; ... 8 tall bamboo staves of 40 feet or more in length ; ... 8 smaller bamboos...from 20 to 40 feet. Leave most of your heavy flagstaves behind you, as also the large instrument, your barometers, and other apparatus. ...
>
> I shall be satisfied if the sites of the towers are well selected even if you do not take a single angle, or observe the pole star once. You will find this task will furnish you ample occupation during the ensuing cold season[3].

Everest found ray-tracing by minor triangles an excellent means of filling in geographical detail between his principal stations, and claimed that it was infinitely superior to route survey, which depended for direction entirely on a magnetic compass, whereby "the individual angles are rarely determined to within 5 minutes, and by...combination not infrequently shew errors of 5 or 6 degrees". By ray-tracing individual angles "can always be determined to within a few seconds of the truth", and accumulated errors "rarely exceed half a minute".

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[1] *GTS.* II (41–3). [2] Report 1836 ; description, Dholri TS. [3] DDn. 321 (262–8), 11–8–34.

During season 1839–40 he employed four small parties for such work along the Great Arc [43]. The first comprised W. N. James and Keelan—the second Radhanath Sickdhar and Nicolson—the third, Clarkson and Kirwan—the fourth, Lane and Andrew Olliver. James' party, with an 18-inch theodolite, started from Kaliāna on the 15th February, fixed the position of Karnāl and surveyed the Jumna River, and closed on Amsot station on the 20th June.

> A...better executed series...of its kind...I have never seen. There are certainly errors which I should term rather large in some of the triangles—in one instance...17″ and frequent instances of 10″—but these seem to have compensated each other instead of combining. ... If it could always be calculated on, I should...recommend this same system of minor triangles in all flat countries, in preference to every other. ... Minor triangles...imply a series...whose sides are so small that they may be treated as plane figures [18]. ...
>
> The church and cantonments of Karnal are the westernmost points, after which the series...runs along...the Jumna, ... one half of the stations being on one side, and the other on the other side. It is greatly to be wished that the course of every river in India were equally well determined. Besides...38 triangles...there were laid down...130 points by intersection; ... temples, forts, houses, mosques, churches, ferries, ghats, and such-like remarkable features[1].

In fixing village sites the triangulator observed to a flag on a prominent tree and plumbed to a stone marked with the usual circle and dot.

Radhanath Sickdhar ran a series from Kaliāna to Nojli between 26th February and 12th May with a closing error of only 6″[2]. The two other parties worked south of Kaliāna, connecting the principal stations in the direction of Meerut.

Everest attributed special virtue to this method of survey from the absence of any ground measurement, or use of the magnetic needle, both sources of inaccuracy. Distances for the sides of the minor triangles were deduced from the computed side between the two principal stations connected, and the problem of breaking out from a very long base to short-sided triangles was avoided for, "provided we know the ratio these lines bear to one another, and also the angles at which each successive two meet, we may determine the absolute value of each line, and also the angles" at the opening and closing stations.

> I have been particular...in dwelling upon these operations...as constituting some of the most beautiful topographical work which has ever been performed. To me they are peculiarly gratifying, ... for they seem to solve the question...as to the best method for carrying on topographical surveys, ... from which instrumental errors...are altogether eliminated. ...
>
> Dispensing with chain measurements eliminates...half...the labour, and gives the operator so much more time...to the observation and careful registering of his angles. ... Rivers, streams, roads, and other features—...at the points where they cross the sides of the minor triangles—all laid down with accuracy...quite sufficient for the purposes of the Atlas—indeed the whole matter collected...is sufficient to render a map on the scale of 4 miles to an inch densely filled[3].

During the next season also, whilst Everest was making astronomical observations at Kaliānpur, he sent out similar detachments to collect topographical data.

> I detached Captain R. Shortrede...to commence...a minor series along the rays Kaliānpur to Kamkhera, to Bhaorasa. ... Much ought to have been accomplished, ... but...Captain Shortrede made one of the most utter failures on record, ... and, although from the 17th December 1840...until April following he was exempted from all other duty, ... yet to this hour no report has ever been furnished, and the angle books, when examined in my computing office, exhibit such enormous errors as to render the materials collected utterly irreducible. ...
>
> A very different result attended the other operations...of a like nature conducted by the northern party of the Great Arc.

He commends Clarkson and James and specially mentions Radhanath Sickdhar's rapid perambulator traverse of the return march through Bharatpur;

> It will...show the zeal with which he discharged the duty, ... as well as the rapidity with which the method admits, that although my camp proceeded by the regular stages, and only halted two days at Alwar, and one at Tijara, the surveying party kept pace...throughout the

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[1] Report 1842 (45–6). [2] Angle books, GBO Comp., F. 15 (18–20). [3] Report 1842 (83, 87–95).

> journey. Radhanath was aided by the other sub-assistants, Messrs Nicolson, A. Olliver, Kirwan, and Ramdial. The instruments at his disposal were a perambulator of my own construction [145–6], and a 5-inch theodolite by Robinson, my private property, of the form called the howitzer pattern [144]. ...
>
> The discrepancies are not only in some instances large, but...there is an irregularity in them. ... But they are not larger than perambulator measurements are usually liable to, and we have the means of correcting them, which in other such measurements are wanting. ...
>
> Though laying down the courses of rivers and streams is not the express end of...the G.T. Survey, yet...I have not failed to avail myself of every occasion which offered to fix points trigonometrically on or near their banks, whereby the existing directions, whether derived from former surveys or resting on pure imagination, may be corrected.

Thus, though Everest was not officially expected to fill up his triangles with topographical survey [13–4], yet, when it could be done without detriment to his main operations, he was ready to divert a certain amount of attention to objects of purely geographical or topographical interest. He made no attempt, however, to turn his chart into a geographical map as Lambton had for the south peninsula [II, 277 ; pl. 17], nor did he venture on the topography of the mountains ;

> Besides the principal station of Banog, which belongs to the Great Arc series, there are many secondary points in the Sub-Himalaya range laid down trigonometrically, the heights of which have in most cases been determined, yet I have thought it best to abstain from any attempt to delineate this mighty mass, for to have done so would have demanded a greater degree of skill than I could command. ... I have thought it best to insert the given points...and leave the ornamental positions to be inserted by those who are more able to do justice to them.
>
> The map, as such, ... cannot lay claim to be a first-rate specimen of topography. It was not constructed with that view...but when combined with the numerical values of the latitudes, longitudes and distances [101–2], ... it will be fully efficient as a guide to enable the...Geographer to incorporate its materials with the Atlas[1] [292, 303].

TOWERS

The need for building substantial towers to carry the triangles of the Great Trigonometrical Survey across the plains of Bengal had been foreseen by Blacker [III, 263], but the expense had appeared to him prohibitive. The problem had, however, to be faced when Olliver brought his longitudinal series down to the plains, and had to cross more than a hundred miles where lofty trees were thick and close [III, 263–4]. Relief to a limited extent was provided by the single line of telegraph towers on the south flank [III, 272], but there still remained the north flank. After careful reconnaissance by Rossenrode a number of towers were put up in rough fashion that would just serve the purpose.

On Everest's return towards the end of 1830 the line had been brought to about sixty miles west of Calcutta, with four telegraph towers to be occupied and five new towers to be built [58]. His first concern was to insist that the instrument should be isolated from the platform on which the observer and his attendants worked. Olliver had already noticed considerable swaying on the tops of the telegraph towers and, after making a visit to test this "with a very sensible level", Everest had the upper ten feet or so reconstructed, so that the weight of the theodolite and its pillar was carried on beams specially let into the walls [82].

The towers constructed under Rossenrode's supervision were only about 40 feet high, but the last three had to be over 70 feet, and Everest thought it better to entrust their design and construction to professional builders. He was specially pleased with the two 75-foot towers built at the extremities of his base-line on the Barrackpore road by the Civil Architect, Mr. Parker [49], but the tower built at Gopalnagar under Captain Bell, executive engineer[2], collapsed and Bell asked that the site should be shifted to better ground at Bhola. Everest thought

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[1] Report, 1842 (108–29, 233, 239).

[2] Wm. Bell (1792–1836). Ben. Art. ; Supt. PWD. Cuttack 1835; plan and section of tower & site, MRIO. 50 (1).

> the fall of Captain Bell's tower...to have occurred in precisely the manner which Mr. Parker opined as likely to happen, viz., ... an insufficient foundation. ... As the lives of my subordinates, and perhaps my own, are liable to be the forfeit, I earnestly hope that the accident ...will be considered as a warning sent by Providence, who in its mercy has not willed that we shall be hurried out of the world in the performance of our duty.
>
> Mr. Parker has had much experience in building on the alluvial lands of Bengal, and... the foundation which was thought by him adequate at the...towers on the Barrackpore road may be used as a standard for the new tower which Captain Bell is about to erect[1].

Parker's two towers on the Barrackpore road are standing to this very day, but the towers of Olliver's series were found in ruins when the series was re-observed in 1869 ; at some of the sites not even was a markstone found[2].

Before the actual construction of the base-line towers at Calcutta, Everest gave his general views on the need for such towers on the Great Arc and the subordinate meridional series. He pointed out that the towers which Jesse Ramsden had devised for observations in England had been found unsteady though only 40 feet high. He thought that in India the masonry columns to carry the instrument would have to be a good deal higher, with a separate scaffold for the observer. "Towers of any magnitude will only be required in the vallies of the Ganges and *dooab*, and the alluvial lands of Bengal and Orissa"[3] [13].

After his first rapid reconnaissance along the line of the Great Arc in 1833 [15, 25–6], he put forward definite proposals :

> It will be necessary for me to choose the sites of the towers, about which a great deal of circumspection is necessary because they are costly. ... I hope to limit the number to 20 or 25, of a height not exceeding 40 feet [26, 83]. I think the form which I adopted in Calcutta in the first instance is the best, ... with the following modifications.
>
> Average height 40 feet instead of 75—thickness of walls 3½ feet instead of 5 at the base—area at top 9 feet square instead of 7 feet square. The increase of area at top is that the large theodolite may be admitted. I shall try...to allow of its being raised inside, in which case a simple windlass will suffice, but if that cannot be contrived without weakening the building, it must be raised outside by means of a portable crane[4].

Orders were given to the executive engineers at Meerut and Delhi, and Everest specified his requirements in November 1833, when starting out to select

> the sites of the towers, and to determine the smallest height which will answer for each. Their form is that of a truncated pyramid, with a square base ; the side 12 feet at top.
>
> The upper floor is so arranged that the large theodolite shall be supported on a round table 42 inches in diameter, with four legs. This table is a fixture, and its legs are morticed into two beams which rest on the walls of the tower and support the terrace.
>
> Above these beams there is a platform with a railing 3½ feet high, and in the centre a circular aperture 1 inch in diameter larger than...the table. The surface of the platform and the table are of equal height, but the latter is isolated, so that people may walk on the former without communicating any motion. ... The platform projects beyond the walls of the tower and is provided with iron rings by which the ropes of the observing tent may be held. ...
>
> In the middle of the base of the tower a large stone is sunk endwise, its whole length in the ground—5 feet in length, 6 inches square at top, and 12 inches square at bottom are the best dimensions—This marks the station [circle and dot then cut]. ... To bring the instrument truly above this, the table must be perforated by a hole 6 inches in diameter[5].

In some towers the instrument was isolated on "two large stone beams, on which rests a cylindrical well of masonry, surmounted with a circular slab of sand stone"[6].

Regarding foundations, Everest pointed out that

> the Telegraph Towers built in the flat alluvial lands of Bengal are in many instances 90 feet high, ... built upon gratings. The Ouchterlony monument has a foundation...of 16 feet, built on piles of 24 feet. Its height exceeds 120 feet. ... The two towers erected by Mr. Parker ...on the Barrackpore road...are each 75 feet, and the foundation is only 12 feet in depth.
>
> The tower erected by Captain W. Bell...is also 75 feet, and has a foundation of only 12 feet. There was a tower erected by that officer nearly on the same site with a foundation of only 8 feet, which when it had been raised to the height of 70 feet tumbled down, but it was the

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[1] DDn. 266 (143–4), 2–2–32. [2] DDn. 159 (19–103), 1–6–68 ; *GTS* trig. 79 B. [3] DDn. 265 (261–91), 12–10–31, para 48. [4] DDn. 286 (61–9), 15–9–33. [5] DDn. 287 (231), 27–11–33 ; sketches, *GTS*. II, pls. 1, 2. [6] *GTS*. II (44) & *Meridional Arc* (xxii–iv).

> opinion of the architect that the fall arose from the negligent manner in which the masonry had been put together [81-2][1].

He wanted the tower at Saini built 50 feet high on an existing mound ;

> Saini had been consolidated into a mound for a period running far back in the ages of fable. The native tale...is that it was the gateway of a city...and that the god Buldeo in his anger ran his ploughshare through it, and overturned it. It appeared to me when I dug out the trenches for raising the mast and scaffolding that the material was a stiff clay, with old brickbats, remnants of earthen pots, etc., firmly embedded in it, and...I should have pronounced the mound of Saini to...require hardly any foundations at all.
>
> The mound was upwards of 50 feet above the surrounding plain, and the executive officer at first proposed a foundation of 51 feet in depth. I suggested 7 feet as the utmost, and the Executive Officer at last consented to reduce the depth to 20 feet, still exceeding by 8 feet the foundation given by Mr. Parker to each of the towers on the Barrackpore road...where we had the rotten alluvial soil of Bengal to contend with[2].

The cranes put in by the engineers were abandoned, and the theodolite hauled up by portable ones constructed by Mohsin Husain [125].

> The balance cranes having been made fixtures, ... when placed in either of the corners of the south face cast a shadow over the heliotropes, and when occupying positions in the corners of the north face, intercept, as often as not, the rays from some one or other of the stations to be observed. ... I was...reduced to...making 2 cranes, one for the sole purpose of extracting those put up, ... preferring...to carry my cranes with me. ... In fact, a massive post of dry sal timber fixed into masonry and standing directly in the way—is a more formidable obstacle than a forest of trees[3].

The towers were not all of equal workmanship ;

> The tower of Noh which was constructed by...the Executive Officer of the Agra Division, stands...pre-eminent amongst all. It is indeed a perfect model of symmetry and elegance. The masonry so beautifully pointed, the faces and angles of the pyramid so sharply delineated. The woodwork all so closely fitted without a chink or crevice of any kind ; ... every feature marks the master hand, and...he has left the walls quite unplaistered, so that any defects which did exist would be immediately manifest.
>
> I wish I could speak in like favorable terms of the towers constructed by the Executive Officer at Delhi. ... The towers of Dholri and Bostan are, from the base to the summit, constructed of such inadhesive materials that they...must soon fall entirely to ruin. ...
>
> Keeping...the instrument...isolated with respect to the observer's stage seems to have been entirely lost sight of. ... The parapet wall...literally fell to powder by the action of the wind ; a brick had been thrust in here and there as if by accident. ... I never saw or imagined buildings so fatal to the pretensions of the architect who constructed them. They were commenced, I believe, by Captain De Budé [III, 437], and for those which are rotten from the foundation...that gentleman is, I presume, alone to blame[4].

Everest had fourteen towers on the Great Arc—two 40-feet, one 60-feet, and the rest 50-feet high, of which thirteen are still in good condition in 1954. The average cost came to Rs. 2,138 [15]. Besides these, there was the observatory at Kaliāna, 14 feet high, and "three renovated ruins, viz., Bulandsheher mosque, Aring castle, and Pir Ghyb durgah at Delhi". In 1865 three new tower stations were added to convert this northern section into a series of double triangles [41 n.5 ; pl. 5].

After completing observations Everest obtained permission to hand over the towers to the civil authorities for safe custody [86] ;

> The plan...proposed is to request the Magistrate or Collector...to incur such expense as he may judge necessary, ... to be paid by me on his demand and recovered in my contingent account. This seems...the most economical because gentlemen on the spot can surely fix a more equitable rate of hire than I can. ... In fact...the Collector and Magistrate of Bulandsheher...has hired a chokidar at each of the towers of Bostan, Karol, at the rate of 2 Rs. a month. ... If I am to hire people, I certainly cannot promise to do it under 4 Rs. a month each, and one such person will be necessary for each tower[5].

Everest's towers were imposing structures [15], and the civil officers were fully impressed with the importance of their responsibility. After receiving charge of the Chandaos tower the Collector of Aligarh reported that he had directed

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[1] DDn. 289 (58-62), 28-5-34. [2] DDn. 286 (181-6), 16-2-35 ; para 23. [3] DDn. 346 (6-8), 5-1-36.
[4] Report 1836 (25-9). [5] DDn. 286 (259-60), 30-6-36.

> the police of Khyr-Chundous to station two burkundauzes at the tower, and [asked]...if any objection exists to give admittance to natives of respectability who expressed a curiosity to see it. ... The keeping it in proper repair rests...with the Executive Engineer of the Division[1].

The surveyors who re-observed at some of these towers in 1866 reported that

> the masonry...was as good, or better, than when it was built, but most of the timber was eaten away or destroyed. Those towers...were built up pucka, very strong and massive, and generally in three stories, and have...lasted uncommonly well. It is but natural that all unprotected timber should have rotted away. ... The whole of the old wooden platform at the top...were generally found to have been almost entirely destroyed by weather and insects.
>
> The roof, ... consisting of a lime flooring placed on small rafters supported by two massive stone beams on which the pillar for the instrument rests, appeared to be in good order[2].

Everest had at first intended that similar towers should be provided for the subordinate meridional series. Their great expense, however, led to reconsideration, and it was found that by shortening the sides of the triangles across the plains not only was it possible to work with very much lower and cheaper structures, but the surveyors had much less difficulty in clearing their rays [6, 76]. On the Great Arc, writes General Walker,

> it was partly with the object of constructing his chain of triangles with as few links as possible that Colonel Everest had such lofty towers built. The sides of some of his triangles on the plains of the Doab were as much as 32 miles in length. But the observation on those long sides were taken with extreme difficulty; the signals were only visible when considerably elevated by refraction, and the rays of light...invariably grazed the surface of the ground, and were liable to be greatly distorted. The observations were far from satisfactory; the delay was enormous, and the anxiety heartbreaking [27-37]. ...
>
> The true course was...a diminuation of size. ... The disadvantage of an increase of number would be more than counterbalanced by the superior accuracy...and the rapidity with which the operations would be performed. ... In all subsequent triangulations over the plains the average length of side has been restricted to about 11 miles. This...was attended with a corresponding reduction in the height of the stations and a simplification of their structure.
>
> At first the primitive form of a tower of loose stones or earthwork or mud, with a central markstone, was reverted to in...some instances. ... In others, masonry columns were erected for the theodolite...and the observatory platform was supported on a portable scaffolding... carried about from station to station [65-6]. ... The towers had no central pillar isolated from the platform...and the columns, though isolated, ... were exposed to the full force of the winds, and were liable to considerable tremor during gusty weather. ... Neither of the two forms was entirely satisfactory.
>
> Eventually...a form of tower was adopted having a central masonry pillar surrounded by a solid platform. The pillar was usually about 6 feet square at base, and was contracted as it rose, ... to within 6 feet of its full height, when it was made circular with a diameter of 3 to 4 feet. ... The platform—usually constructed of earth-work—was made to abut against the lower and square portion of the pillar, but was isolated from the upper circular portion. ...
>
> These stations were constructed at a tenth part of the cost of...towers on the Great Arc, and with vastly greater facility. ... Skilled labour being no longer necessary there was no further need to invoke the assistance of the...Public Works, and the structures were... erected by artificers...from the nearest villages, ... Cranes...for hoisting the theodolites to the summits of the towers...have been dispensed with, and flights of steps have been constructed[3].

Hasty construction led to inferior workmanship and often to actual collapse. Armstrong found two of his towers very much out of the perpendicular, and

> at this station in a most dangerous condition. Its inclination is about 1 foot to the east; its basement cracked in several places, and curved in all manner of shapes, and the body... exhibits several chinks.

To avoid delay he hoisted his theodolite to the top, and risked the whole tower coming down in a gale of wind. To mark the exact point of observation he got the Executive Engineer to construct "4 small pillars at right angles at a distance of about 100 yards," so that the point of intersection of the cross lines should mark the point of observation[4].

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[1] DDn. 345 (70), 21-3-36. [2] *GTS. Report, 1865-6* (xxiv), 27-9-66. [3] *GTS.* II (44-5); Everest had each towers oriented to the meridian. [4] Ranghir Series; *GTS.* VII (xiii-xiv); DDn. 380 (85-6), 26-3-39.

Renny, on the Amua series, was one of the first to make do with cheaper material ;

> I have...brought old mud forts into use by repairing and raising one of their towers, and ...I have heightened a tower about 18 feet. ... I...raise towers of mud to the height of 25 feet, and of 16 feet diameter at top, ... at an expense of within 2½ Rs. per foot of height [67, 84]. ...
>
> If placed under the...Executive Officers, an occasional rupee or two for re-plastering after the rains would suffice to preserve them for any number of years, of which the numerous mud forts in this country, and the kutcha walls of the native huts, afford ample evidence ; or, after the observations are completed, the tower can be pulled down, and a simple platform of 2 or 3 feet in height, surmounted by a pile, left to mark the station[1].

The highest of Renny's towers cost less than Rs. 100, and he reduced the average cost of clearing the lines between them to the same figure, including compensation. The cost of a masonry tower high enough to dispense with clearing would have cost over Rs. 2,000. He gives a note on mud construction[2] ;

> The mud forts in India...prove the tenacity of mud when properly worked. ... No experienced person could be found, ... and...much had at first to be left to the discretion of the kalashie superintending. ... until occasional failures pointed out the necessary precautions. ...
>
> The mud ought to be prepared at least one day before it is required...by mixing water with the most tenacious earth at hand, and working the mixture well with the feet. ... The building is carried on in...horizontal layers, each 18 inches high, as it is requisite that one layer be well dried before another is superadded. ... In...each layer the outer edge is first raised with a breadth of 1¾ or 2 feet, and after a lapse of 24 hours the interior is filled up.
>
> It generally requires 5 days to dry each layer, ... and during the 2nd and 3rd day of that period, the outside, originally built rugged, is while yet moist beat with wooden mallets into the required shape. I intended the platforms to have a slope inwards of 1/8th the height, but...slopes are mostly one in five or six. ...
>
> The ascent is usually...by means of a flight of steps, with...a one-foot tread and 8 inch rise, ...a breadth of 5 or 6 feet, and sides sloping to the ground like unto the platform. The whole is plastered over with a mixture of slime from the bed of jheels, cow dung, and, when procurable, the coarse husks of grain.
>
> A markstone is inserted within the centre...on a level with the base of the platform, and 4 marks are laid off outside and on opposite radii of two lines passing through the centre mark. ...
>
> Before the commencement of the last rains I had the platforms covered over with a slight thatching, and none of them suffered in the least. ... The greatest height...I have attempted is 24 feet, but, with tenacious earth and a good builder, I could without hesitation venture on 30 feet. ... The level of the instrument was in no manner affected by the movements of the observer or his attendant in the observatory tent[3].

Waugh describe a form of tower which he built for about Rs. 160,

> of unburned bricks, with the exception of the central core...which is of masonry, isolated from the external portion of the tower. ... The platform at the summit is from 16 to 18 feet in diameter, and the dimensions at the base are increased in proportion to the height. ...
>
> The ascent is accomplished by a circular flight of steps—4 feet broad, each step having a tread of 8 inches to a rise of 6—...built at the same time with the tower, and connected therewith, the bricks breaking bond fairly, otherwise the staircase will be liable to separate. It should be also constructed with the same batter externally as the tower itself[4].
>
> The height...may be deduced from the curvature of the earth, ... reduced by the altitude, if any, of the general level, and increased by the height of any intermediate obstacles. ... The line of vision should pass about 5 or 6 feet above the ground in the centre of the ray. ...
>
> The depth of foundation is...connected with the height of the tower and the nature of the soil or subsoil. ... Where the site is not elevated...precautions should be adopted to prevent the lodgement of water near the foot of the tower. In lands which, like the terai, are subject to inundation, ... it will be advisable to construct the foundation and plinth of burnt bricks. ...
>
> In the event of water insinuating itself between the masonry pillar and the mud tower, the latter would inevitably burst and become speedily ruined. To prevent such a result, it is usual to cover the whole terre-plein...with terrace plaister. This...has been found not to disturb the requisite...isolation[5].

Shortrede was much exercised as to whether to have his towers built by the Public Works Department or by his own men ;

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[1] DDn. 322 (200-1), 1-11-35. [2] Similar to the *adobe* of Mediterranean countries. [3] DDn. 382 (159-62), 13-11-36. [4] in a later pattern a ramp took the place of the steps ; DDn. 499 (168-70), 29-8-46. [5] DDn. 435 (169-73), 1843.

> If the towers are to be built by the Executive Engineer, I shall be dependent on...a department already fully employed on other works; and before I can undertake to build them myself I shall require some better security...that I shall really recover by contingent bills on honour the sums I may have occasion...to spend, without incurring the risk of heavy pecuniary loss[1].

For the next thirty years the construction of towers remained an essential feature of the operations of the survey.

STATION MARKS AND PLATFORMS

The normal method of marking a station of the Great Trigonometrical Survey was by a circle and dot, cut for preference on solid rock or on a substantial stone buried upright below the instrument. The marks were

> afterwards covered over with cairns of stones, or piles of earth, which served the double purpose of protecting them from injury, and indicating where they were to be found.
>
> Subsequently the necessity arose for raising stations...above...the ground, and then a mark-stone was inserted in the ground, and a platform built over it to the required height, when another mark-stone was inserted on the top, in the normal of the one below [31]. These structures were always made of such materials as were available on the spot, sometimes of... stone, sometimes of dry earth, but more frequently of mud [64, 84].
>
> At the...stations of the two northern sections of the Great Arc...central masonry pillars were erected for the instruments, ... isolated from the surrounding platform [82]. ... [For] increasing the durability of the station and facilitating its subsequent identification, ... a masonry pillar was constructed over the mark even when rock was found *in situ*, and a mark...engraved on it. ... On the upper surface...a stone was inserted with a second mark, ... and whenever pillars of a considerable height were built, intermediate markstones were...inserted[2].

It was of course essential that these marks should remain undisturbed until the conclusion of operations, in order that the observer's instrument, as well as the heliotrope, lamp, or other signal, might be accurately centered over the same point. Deliberate interference was, however, frequent, and most difficult to guard against. In some parts writes, Everest, these platforms are regarded with

> idolatrous veneration, and there are some amongst the villagers who, I am told, make money by pointing out the centre and circle, ... and descanting on its holiness and marvellous powers.
>
> In other parts of the country the most preposterous stories are propagated regarding the incantations and ceremonies gone through in achieving this magic mark and laying it in the platform, such as that young pagan children—obtained by stealth if possible, or...by purchase—...are offered up as sacrifice and that their skulls bear testimony to the fact. ...
>
> My harmless platforms and their central stones are looked on as the cause of every ill which afflicts the country and, in the case of scarcity, the rulers, taking advantage of this, ... proceed ...not only to pull the pile to pieces, but in some cases to erase altogether the lower centre concealed underneath it, ... which...cannot be effected without the repeated blows of a sledge hammer [III, 415; IV, 161, 266][3].

From one station Renny reports "that some person had been at the trouble of digging out the mark, ... not for its use, but...from motives of superstition or mischief, as it was lying by the side of the pit from whence extracted"[4].

This was a trouble which cropped up frequently in all parts of India, and may be partly attributed to a superstitious respect for the lonely solitudes of mountain tops and resentment at the instrusion of strangers. The disgust felt by Everest and other surveyors at the wanton damage to their work, and the feeling of frustration at the loss of hard-won results can be well understood. It was repeatedly pointed out to local officials that the preservation of the station marks was essential for future surveys, for, writes Everest, "the stations...are of no earthly use...if they are eliminated before they have been applied to topographical purposes. It is as if they had never been. They return to the nothing that they were"[5].

It was not until 1869 that a regular system was introduced of entrusting all station marks of the Great Trigonometrical Survey to the charge of district officials, and calling on them for annual inspection and report [83-4].

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[1] DDn. 520 (24), 27-11-43. [2] *GTS.* II (43-4). [3] Report 1836 (60-4); *GTS.* II (72-3).
[4] DDn. 322 (73-5). [5] DDn. 402 (115-22), 11-9-40.

Though the familiar work-a-day signals such as stone cairns, wooden poles, bundles of brushwood, and cloth flags, were still used on reconnaissance, and for approximate or minor triangles, Everest insisted that observations for principal triangles should be made to luminous signals, by day to heliotropes, by night to blue lights or vase lamps [III, 246–8], or to the more elaborate Argand or reverberatory lamps. One of his first criticisms on Shortrede's work in the Deccan was the slovenly nature of his signals which were

> generally trees from 10 to 20 feet in length from which the branches had been lopped. ... They were set up exactly over the station mark and supported by large stones piled round their base. On the observer arriving at the station the pole was removed, and erected again on his departure. But a perfectly straight tree was not always procurable...and the poles...were liable to be broken or canted to one side by the wind[1].

Blue lights showed brilliant light to a great distance, but, writes Everest, were

> objectionable in many respects [20, 77]. They cannot be employed excepting in calm weather, and the composition is so inflammable as often to be quite unmanageable. They are liable to burst in burning, and the flakes of liquid fire scattered on such occasions endanger every surrounding object. But besides this...there is a constant stream of burning lava falling from them, and a dense smoky gas emitted, highly injurious to all metallic substances[2].

They were sometimes made up by the Commissariat, though Everest found that a consignment from the arsenal at Agra were but "poor rips" ; it was far better to get the ingredients himself, and make them up in his own camp [III, 247–8][3].

Programmes carefully worked out between the observer and his blue-light signallers often went wrong, as Everest repeatedly found on his strenuous operations across the *doāb* [III, 399 ; IV, 29–35]. He writes to Radhanath Sickdhar ;

> Be prepared to burn 4 blue lights this evening. The sun sets in this latitude at 5 hours 20 minutes, and you will burn your first blue light at 8 o'clock, or 2 hours 40 minutes after sunset. Your second blue light at 8 hours 20 minutes, or 3 hours after sunset. ... and your fourth 20 minutes after your third
>
> Do not be flurried, but be quite cool and collected, and then I know you will do right.
>
> P.S. If the day happens to be dusty, and the evening cloudy, do not burn the blue lights, but defer it until you hear from me again, in which case be sure to send me word.
>
> [this did not work] ;
>
> I saw nothing of your blue lights this evening. ... I now send with Pelagagee four blue lights which he is to burn at intervals of 20 minutes commencing as soon as it gets dark. I left 6 blue lights with you, and ordered you to burn 4, so that...you must have 2 remaining ; those 2 you will give to Pelagagee, who is ordered to burn 6 in all[4].

and to Olliver after one of his more disappointing nights ;

> Yesterday evening was the most unfavourable we have had. ... Of course I saw nothing of your blue lights, and if you had burned 50 in a bunch they would have been unable to pierce through the dense fog which obscured the sun a full hour before sunset. Mr. Rossenrode has also burned 4 blue lights at Saini, for which of course nobody was on the look-out, for who could suppose that blue lights would be burned in such a state of the atmosphere ?
>
> I do not know what orders to give. ... It is no trifling matter to sit for hours on this scaffolding looking out, and when one's labour must be...thrown away it is a most distressing task. It is easy enough for those who burn, but it is a very different story for those who observe. The only remedy is to wait for further orders[5].

He had brought out a small supply of heliotropes in 1830, but not nearly enough. Surveyors were sometimes delayed several weeks at the beginning of a field season making up their own heliotropes from bits of mirror collected from bazaar or city [69, 74]. Others were more skilfully constructed by the Mathematical Instrument Maker at Calcutta. Time had to be spent in training *khalāsis* in their skilled handling, to direct and hold the sun's reflection on to a distant station.

To an appeal for heliotropes for work on a minor series, Everest replies ;

> I have ordered 6...to be made by the Mathl. Instrument Maker for the Boodhan Series. It is a mistake to suppose that I am not fully alive to the advantages of the heliotrope in all principal triangles. My reasons for not sending any on the Boodhan series were that I had

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[1] *GTS*. XII (iii–B). [2] Report 1836 (12). [3] DDn. 321 (133–169), 9 & 28–2–34. [4] ib. (113–4), 29/30–1–34. [5] ib. (171–2), 3–3–34 ; cf. Macdonald on Budhon Series [62].

> not more than sufficient for the Great Arc. In minor triangles the sides of which are less than 10 miles I have never found them of use.
>
> The heliotrope is not without its objections; it calls for great patience and care. ... It requires the direction of the ray to be well known, which is the very purpose of any minor series, and the intervention of cloudy weather—however clear the atmosphere may be—thoroughly counteracts its effects.
>
> It will be quite impossible to supply heliotropes in sufficient number for the rays of all secondary as well as principal triangles. ... I have sometimes found myself without a heliotrope to spare. In that case the simple expedient of cutting a hole in the silvering at the back of a looking-glass has supplied me with a spare heliotrope[1].

Jacob reports that some of the heliotropes on the Bombay triangulation were

> made by Mr. Barrow...of a plane circular mirror of 8 inches diameter, in bronze frame, mounted on a tribrach with foot screws and, having rack-work motions in altitude and azimuth. Others were made up at Poona and, though rudely constructed in wood, and requiring to be set by hand, were yet found to answer remarkably well. They were directed, sometimes by a plain ring with cross wires set on the top of a staff, but more usually by a large triangular sight-vane with holes corresponding to different distances. This being painted in black might...be sometimes observed as an opaque signal at...less than 30 miles[2] [89].

Heliotropes were by no means child's-play to manage, and Everest writes to Keelan, near Delhi, 30th January 1834;

> I can see your heliotrope well enough when you choose to turn it this way. The fault is not in the ground but in your negligence. It was well managed from sunrise till 10, ... just to shew what you could do if you liked. Then you took it down for more than an hour, and then turned it to me again just for about 3 minutes at a time, as if you were trying how much you could annoy me. I do not know what you mean by all this folly, but I must stay here until I get the angles with it, and you will have to stay where you are. What object do you propose to yourself by playing these silly puerile tricks? Keep the heliotrope turned this way; you have lost me a day already, and I have no time to spare[3].

The heliotrope had been invented by Gauss in 1820, and at a meeting of the Astronomical Society in London in March 1822 a letter was read

> from M. Gauss respecting a very simple contrivance for a signal in geodetical operations, which may be seen at an immense distance. This contrivance is nothing more than the common reflecting speculum of a sextant, being about 2 inches long and 1¾ broad, and mounted in such a manner that it may always reflect the solar rays to the given distant point, notwithstanding the motion of the sun.
>
> The instrument...he calls a *heliotrope*, and the reflected light was so powerful that at 10 miles distant it was too bright for the telescope of the theodolite, and it was requisite to cover part of the mirror. At 25 miles...the light appeared like a beautiful star, even when one of the stations was enveloped in fog and rain; and at 66 miles...it was still sufficiently powerful[4].

Everest had also brought out a number of specially designed Argand, or reverberatory, lamps, which he found most successful after a few modifications, and also some Drummond lights[5] which "were not brought into the field because...they are very cumbersome, costly, and difficult to manage".

The reverberatory lamps were made up to Everest's order by Simms, and comprised an Argand burner with glass chimney, fed from a reservoir of oil, and placed in the focus of a parabolic reflector. These were most efficient, except in

> an atmosphere surcharged with smoke and mist. ... I found their disc an excellent object for intersection in one instance at 41½ miles distant—in an atmosphere not peculiarly limpid. ...
>
> At first...they would not endure any agitation of the air. ... If an Argand's burner be placed beneath a punka...the flame flares against the glass chimney and is speedily extinguished, while if it be covered at top and bottom so as to exclude the external air the light expires from exhaustion. ... I at last hit upon the expedient of enclosing the whole lamp in a wooden case with a tin chimney...and a circular glass aperture fitted into a front door opening with hinges. ... This...has succeeded in a degree surpassing my expectations. ...
>
> After 2½ months of...dusky weather...a violent storm set in from the east. ... The rain fell in torrents, and the gusts of wind were so violent that, but for my being very certain of the strength of the...observing tent, ... I should not have ventured to keep the instrument standing.

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[1] to Bridgman DDn. 373 (57-8), 17-7-34. [2] DDn. 518 (202), Sept. 1842. [3] DDn. 321 (112).
[4] *As J.* XIII; May 1824 (474). [5] designed by Lieut. Thos. Drummond, RE. of OS.; derived brilliance from play of oxygen through alcohol flame on ball of lime; Thuillier & Smyth (390).

> This storm lasted during three entire days and nights and, blowing from the east, the direct force of it was against the two stations of Deri and Pahera, both situated on the westward. ... Yet those lamps never waned for an instant, ... and though...little short of 27 miles, the light was as vivid and steady as that of a star of the 3rd magnitude. ...
>
> I was able to finish all my observations to them in a few hours. The people at the other stations seem to have concluded that on so gusty a night there was but small chance that I should be observing but, after learning their mistake, their lamps were seen equally distinct, ... though the wind had in no wise abated, and the rain and thunder had rather increased.

These lamps were excellent in clear weather up to perhaps 60 miles, and were proof against high wind and storm, but could not penetrate a thick atmosphere. They were a vast improvement on the old vase lights [III, 247 ; IV, 87], in which

> a large earthen vessel with a circular orifice cut in its side being inverted, formed a cover for a small earthen pan. ... This pan...was filled with oil and cotton seeds which were kept ignited. ... In the case of an ordinary strong wind blowing into an open orifice of this sort the light was perpetually liable to be extinguished... the materials were not easily portable. ... in some some parts of the country vases of the form required were not to be obtained. ...
>
> In some parts...oil cannot be obtained, and must be carried, ... or...oil of butter (ghee) must be used. ... When it comes to...conveying about several mans of oil[1], of which perhaps 20 or 30 seers are to be consumed ineffectually at each of 6 or more surrounding stations, night after night, ... the expense...is one of serious consideration [III, 262]. The contingent expences for oil in the old vase lights averaged 180 rupees per month, besides the carriage, for which 20 bullocks were sometimes furnished by the commissariat. The average of two parties is now from 7 to 9 rupees per month for each party.
>
> The first cost of my lamps [Argand]...was ten pounds or guineas each ; one seer or 1½ seers of oil is ample...for a night's expenditure, and this, together with the cost of a few cotton wicks and glass chimnies, ... comprises the whole contingent expence. ... I have...good glass chimnies blown at...a village in the Saharanpur district at the rate of 3 per rupee. It has required 240 to replace those broken by two parties, ... a monthly cost of less than 6 rupees. ... As to cotton wicks, I have not yet been able to get them fabricated in this country, but their cost is exceedingly small[2].

There were still champions of the country lamp and, writes Renny,

> owing to the difficulty the khalashies experienced in trimming the...reverberatory lamp, and in using the nozzle screw, I adopted the ordinary native chiragh—a cotton wick from 3/8 to ½-inch diameter in a saucer—and found it answer very well, ... even at a distance of 11 miles. ... Its light is beautifully clear and small. ...
>
> For azimuth my chiragh was placed...nearly on a level, and about 4 miles distant. I then erected a small pillar...on which a line was drawn in the direction of Umooah, and the wick was always placed above the same part of the line, so that even if the direction of the line were not perfect, no error could occur. The chiragh was protected from the wind by a reversed gurrah, with a longitudinal opening in front, 1½ inches wide[3].

For referring marks at short distance [90–1], Everest advised Shortrede that he

> always made my own lamps of tin with a small spherical reflector. ... The reflector is very simple, ... a segment of a concave sphere...placed behind the light so that the middle of the flame shall about bisect the radius of the sphere. The rays then issue parallel, or as nearly so as can be contrived[4].

To adapt his brighter lights for use as referring marks Everest devised a wooden sight-vanes, with graduated apertures that could be used either by day or night[5].

He insisted on the importance of centring all signals over their marks ;

> Every sub-assistant who may be sent to a station to fix a sight-vane, heliotrope, or lamp, ... is required to send a certificate upon honour ; ... 'I do hereby certify upon my honour that the sight-vane at the station of B— was properly adjusted by myself over the centre by means of the plumb-line, ... and kept in adjustment during the whole period of observations'[6].

As a standard signal, the lighting of a pair of bonfires by the observer indicated that no further signals were required [29]. To ensure that the two fires should not merge into a single blaze when seen from a great distance, it was a standing rule to allow one yard between them for every mile of distance[7].

---

[1] 1 maund = 80 lbs. = 40 seers. [2] Report 1836 (13–23) ; *GTS*. II (x—A). [3] *garah* = earthen pot DDn. 322 (79–92), 1–5–34. [4] DDn. 267 (85–8), 1–11–31. [5] Narr. 1834–5 (22) ; *Meridional Arc* (exiv) ; Diagrams, lamps, heliotropes, sight-vanes ; *GTS*. II (57 ; pls. 9–11). [6] DDn. 356, no. 27–10–35. [7] DDn. 370 (1), 23–2–36.

To turn from the refinements of geodesy to the makeshifts of the humble topographer, a useful signal for a ten-mile ray was the branch of a tree wrapped with thick bundles of grass, and bearing on the top a large round earthen pot from the nearest village, well daubed with whitewash[1].

HORIZONTAL ANGLES

During his two years charge after Lambton's death, Everest had ample opportunity to note the weak points of the great man's systems of observation, recording, and computation, and those of the grand old theodolite itself. He was therefore fully ripe to absorb all that was to be learnt during his visit to the Trigonometrical Survey in Ireland[2] during his long spell of leave.

Fully determined that the work he had the honour of leading in India should be every whit as worthy of confidence as any in Europe, he gave the most detailed instructions to his assistants, and would not admit the smallest departure from them. He was determined

> to improve the survey and tolerate no inferiority in the execution. ... If I have had any reason to suspect any defect in the instrument, or any instability in the platform, or any want of precision in the signal observed, or even if I have found...the angles...presented any discrepancies for which I could not account, I...reject the whole set bodily, and replace it by an entirely new set of angles taken under circumstances free from objection. But to retain part of a set and reject others—to pick and choose—...is...utterly prohibited[3] [III, 352].
>
> Mr. Murphy is, I know, a very good observer but he is too much disposed to strike out systems for himself, and fancy they are new, when they are in fact but a part of the mere exploded practice of early times—exploded because it has been found by experience inferior to that which has supplanted it [92, 259][4].

He instructed all officers on first starting out to acquire the habit of

> extreme care in taking observations, and undeviating regularity in registering them, and... omit no opportunity of scrupulously examining every individual observation, taking the means of all the micrometer readings, ... and deducing each angle. ... The sun never should rise and set twice on an unexamined angle book.
>
> When any set of observations is computed, the arithmetical mean...must be taken forthwith, and the probability of error computed. When the three sets of observations of any triangle are all completed, the spherical excess should be computed, and the error partitioned agreeably to the probabilities. It is never permitted...to reject any observation arbitrarily[5] [110]. The observer should at the time of observing fully satisfy himself of the correctness of the intersection. If he cannot do that, he should not read off the micrometers, but an observation once read off and recorded must not be expunged, and must be used, unless some very sufficient cause of error should afterwards appear[6].

To Western he gave detailed instructions as to change of zero;

> Fix the instrument so that zero shall be under micrometer A, and in that position observe each station in succession, noting down the readings of each microscope. You will then turn the telescope over in altitude, and the horizontal circle half round in azimuth, and observe each point in succession again. Repeat this operation, so that by having two readings at each position of A (viz., 0° and 180°), you will see whether any obvious mistake has been committed.
>
> Having thus obtained four sets of observations for one position, bring 10° under micrometer A, and you will get 4 others, and so on...up to 50°, whereby you will obviously bring every ten degrees successively under one or other of the microscopes. ...
>
> By this process you will have six changes of zero, and 24 readings, which will suffice for a complete set of angles, and you ought not to be satisfied...with less than that number[7].

Oil lamps for reading a theodolite could be a nuisance, and Waugh complains that "the smoke of the axis lamps has been found very troublesome as it ascends through the meridional opening, and passes in front of the object glass".

Referring lamps, or marks, were used when sides of triangles were of considerable length, and when signals were seen with difficulty or for only a few minutes at a time [87]. The completion of the whole round might then be spread over several hours, and even days or weeks. When in clear weather, or with shorter sides, it was possible to dispense with a referring mark, it was the general rule to treat the left-hand station as the zero[1].

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[1] S. C. Macpherson, Hyderābād, 30-1-35. [2] conducted by Colonel Colby [45 n.]. [3] *Meridional Arc* (xxvii); *RS Progs.* XVI, 186-78 (xiii). [4] DDn. 382 (277), 16-4-38. [5] Everest's rule has not been universally accepted; *Cal Rev.* IV (88). [6] DDn. 267 (59-61), 15-3-31. [7] ib. (104-13), 6-2-32; detailed procedure, *GTS.*, II (59-71 ; 82).

Macdonald started to use referring lamps because he could seldom see the blue lights from more than one station each night [62], and Everest warned him never to think of taking the blue light observations without a referring lamp ; but the greatest care is necessary, because the distance of the referring lamp being small, the errors are very large... from any small deviation[2].

To continue the instructions given to Western ;

> When not occupied with principal triangles, ... observe all such eminent points as offer themselves. ... All buildings which can be seen from the station should be intersected. ... Care must be taken to enquire the names of these places, and in the angle-book should be inserted in Persian, and the language of the country if possible, all those names according to the...records of the Collector and Magistrate. ...
>
> On no account...leave any angle of a principal triangle unmeasured. ...
>
> Of the two angle-books which you take from my office, ... one will be returned to me...for transmission to the India House, and the other will remain with you until the survey is completed, when it will be deposited in the computing office of the Great Trigl. Survey[3].

Shortrede was given strict orders about his angle-books ;

> I send you two skeleton forms...to be adopted in all cases without any deviation. ... Indent ...for...those you are likely to want, for I have had many copies struck off at the Lithographic Press. ... If observations are written in pencil in your observatory, they must be put into ink the following day. ...
>
> In...making fair copies the rough draught and the copy must be compared by two persons, and their initials signed at the bottom of each page. All computations should be gone over by two persons who do not compare the intermediate steps until the whole is completed. One copy of the rough documents must be sent to my office monthly if possible ; the other will remain with your headquarters[4].
>
> The angle-book must on no account whatever be suffered to fall into arrears, or be scratched or daubed, or slovenly written. ... At the conclusion of the observations, and before quitting the station, ... a description of the station...should be registered in the angle-book[5].

Macdonald gave his assistants the strictest orders for office routine ;

> Of the two fair angle-books, one is to be considered the *original*, and the other the *duplicate*. The original will never be allowed to fall into arrears. To prevent this Lieut. Macdonald will before breakfast revise the rough copy of the preceding day's work so that by the time Mr. Scully comes to office it may be ready to be...copied into the fair No. 1 (*original*).
>
> As long as the extra sub-assistant remains with the party, there will be no difficulty in bringing up No. 2 also, but if it fall into arrears, it can be brought up in the rains, as it is merely a copy which can be taken by any writer, and afterwards carefully compared with No. 1. ...
>
> To bring up the arrears of computation, Mr. James will exclusively direct his attention to taking out the angles and calculating the triangles and depressions. ... As soon as Mr. Scully has copied the last day's work, Lieut. MacDonald will compare...the fair with the rough, and immediately follow Mr. James in revising his calculations.
>
> N.B. Mr. Scully, after having copied the last day's work, will enter in pencil the mean zeros of all principal angles in the column of remarks, that no zero may be missed. Lt. Mc.D. or Mr. J. will...ink in the column and sign initials on the completion of each angle[6].

The Budhon party spent the rains of 1833 at Saugor, and it was with some diffidence that Macdonald sent his computations and chart to Everest at Mussoorie. There were mistakes, but Everest was kind [62]. After pointing out that in the rains the papers ought to be packed in a tin case [III, 445 ; IV, 195], he added ;

> I am too busy to examine the work thoroughly, but shall do so when I get a leisure moment. ... It is hard to find fault where I am sure you are doing your best, but you will improve in time upon your present work. The system you detail is excellent. Persevere in it and ere long you will attain all the accuracy desirable. Continue this plan of extracting the common side, and putting them face to face. Everybody is liable to do bad work, especially in the outset. I wish all my officers were equally fair[7].

---

[1] *GTS.* II (64). [2] DDn. 374 (51–7), 2–12–33. [3] DDn. 267 (104–13), 6–2–32. [4] to Bombay Svy., DDn. 323 (14–7), 11–11–31. [5] to Karara Series ; DDn. 431 (137–44), 2–8–41. [6] TS. 9 (1–7); Budhon Series, 1833. [7] DDn. 374 (40–1), 12–10–33.

Everest was not content to take work on trust, but wanted regular reports on every detail; Waugh had sent in observations for azimuth without recording the readings of his level bubble, but writes Everest,

> when you depart from a practice to which you have previously adhered with punctuality and to our mutual satisfaction, you owe me an explanation...and assurance that the data, though not transmitted, were nevertheless duly recorded in the angle-books. ...
>
> It would have been much more gratifying to me if...you would have informed me of the condition in which you found the platforms...—whether you referred to the lower station marks, and duly centered the upper station marks with respect to them—whether the instrument... stood upon an isolated pillar—and...other particulars. ...
>
> It is as necessary for my reputation as your own that I should be furnished with facts on which to rest...that confidence. ... In fact, ... it is not only necessary that the work should be executed and registered on the best possible style, but it is also essential that the Superintendent...should be convinced thereof by facts, and...explain to the satisfaction of mankind in general the manner in which each...portion has been conducted[1].

Of all his assistants, it was in Waugh and Renny that Everest placed the fullest confidence:

> Where these two officers have been concerned, the registry of every item elucidatory of their observations is so systematic, and so precisely according to rule, that it seems to me as I had myself been present to arrange them. ... When their materials reach my office they need no interpretation, but are as intelligible to my computers and sub-assistants as if they had written them with their own hands [309]. ...
>
> No person could have more entire reason to be satisfied with his subordinates than I have, for the great and ruling object with one and all of them seems to be to study to conform to my system, comply with my wishes, and save me trouble[2].

The one officer who persistently failed to meet his wishes, and could never appreciate the insistence on minute detail that Everest considered so important, was Shortrede who, though a mathematician of the highest order, had little faculty for applying his learning to the practical details of everyday work, and had no fine sense for the essentials of high precision.

When submitting registers of his work before handing over to Jacob, he enclosed corrections to a chart previously submitted, and described an innovation he had introduced into his computations. "I have got some very beautiful equations admitting of an easy application"[3]. Everest was severe;

> It is to be regretted that there should be this necessity for revision, correction, and insertion of errata relative to documents which, when sent to my office signed by yourself, ought to be in a fit state to be considered final. ...
>
> I am at all times happy to receive any suggestions, ... yet I cannot admit that any person, however highly talented, is privileged to employ formulae in his computations without previously obtaining my sanction. There must be but one uniform system pervading all the operations. ... The formulae which have for...years been used in my computing office must be adopted by every member of the G.T. Survey under my orders, to the exclusion of all others[4].

Jacob hastened to explain that Shortrede had only made slight changes in a method adapted from "a theorem furnished by yourself in the year 1837", but to prevent future misunderstandings, Everest sent out a circular calling for

> the strictest uniformity in all...operations, whether as regards observing, registering, or computing. ... Until my consent is obtained, no innovation on prevailing methods can be permitted[5].

It is sad that the last official contacts between these two should have been on an unhappy note. Everest writes just a month before he left India for good, acknowledging "a string of angles" which Shortrede had observed the previous season;

> My letter of the 2nd August 1843 gave cover to a form for your...guidance, which you have not abided by [91]. ... I must...desire you will...make it your study to conform strictly to the usages of my office and the forms you receive therefrom. ... The list...you have sent... neither gives individual observations, nor the number from which each resultant is drawn, both of which are necessary to enable me to form an estimate of the character of the work. ...
>
> Non-conformity involves...the direct violation of a solemn pledge, made by yourself, ... on the faith of which alone...you obtained re-admission into my department [359][6].

[1] DDn. 371 (187–9), 11–5–38. [2] DDn. 344 (18–26), 25–2–39. [3] Notes on distribution of errors of triangles, quadrilaterals, and polygons. DDn. 324 (281–4); 325 (19–230, 263–73) of 19–5–40. [4] DDn. 324 (257–9), 22–5–40. [5] DDn. 431 (137–44), 2–8–41. [6] DDn. 435 (113–4), 13–11–43.

Fully realising the impossibility of ascertaining the true value of refraction, Everest endeavoured that "in taking vertical angles...reciprocal observations should as much as possible be made at the same hour and under the same state of the atmosphere". He did not insist on observation at the hours of minimum refraction when—with his long rays—signals were often below the line of sight. He tells Shortrede that before 1830 he had usually observed

> vertical angles...after having finished the horizontal observations. They have been observed at all hours of the day, generally, however, in the morning. ... I have not been able to infer that the elevations and depressions of distant stations were affected *in any certain way* by the change of temperature at different hours. This may in part be owing to the vertical circle of my theodolite being only 9 inches in diameter, and reading by two verniers to 10″. ...
>
> I have made observations from several stations purposely to discover whether any, or what, change was produced in the refraction by changes of temperature at different hours of the day, but hitherto they have guided me to no certain conclusions.
>
> I have from every station observed the elevation or depression of every other station in sight. My observations may therefore be said to be *reciprocal*, but having no one to observe from these other stations, my observations are not *simultaneous*[1].

Failing a second observation party, he instructed Western that vertical angles

> ought, rightly speaking, to be taken at one and the same instant, but as that cannot be managed the next best method is to...observe them about the same hour from noon, for then the errors caused by terrestial refraction are more likely to compensate each other. ...
>
> About 3 or 4 in the afternoon is generally...the instant of minimum, and the same hour after midnight...that of maximum. In certain conditions the difference is immense.
>
> Four sets of observations, two with the face each way, ... are sufficient at each station, and every occasion should be used when the rays cross each other...to get as many points of verification as offer themselves. ... The height of the barometer and thermometer should be observed...as also of the thermometer with a wetted bulb[2].

He has left several lengthy notes on irregularities of refraction [105–7], and concluded that, in flat lands, except at the time of minimum refraction,

> no dependence can be placed on the apparent place of the object observed. But, ... if two observers, ... each supplied with a good theodolite and a heliotrope or lamp, ... be situated one at each end of the ray, so that the eye end of one shall be the object end of the other, and *vice versa*, and...each takes the vertical angle of the other at the very same instant, the fairest chance is...afforded of obtaining a correct...difference of height[3].

He took particular care that vertical angles between stations across the Jumna-Ganges plain should be taken by such simultaneous reciprocal observations. The vertical angles were postponed till the end of the second season, when Waugh and three other observers made a special operation for the purpose [41]. On the subordinate meridians also a similar procedure was followed when possible [66–8].

In after years the results of precise spirit-levelling showed that on the Ranghir series there were occasional discrepancies as large as 15 feet between adjacent stations, and an accumulated error over the whole series of over 50 feet.

> This large accumulation of error is unquestionably due to the great lengths of the sides of the triangles in the plains, which frequently compelled the measurement of the vertical angles to be made at other times than that of minimum refraction[4].

Everest based all his heights on Lambton's value for Damargida, north of Bīdar, 2026 feet, brought up by triangulation from the sea near Cape Comorin[5], but noted that Jacob made this height 1921·6, brought up from the sea at Bombay through the longitudinal series[6]. For the Great Arc he gives tables shewing all the vertical angles observed, and the results deduced. Whilst the majority of the means are struck from two or more values which agree within a few feet, there are occasional discrepancies of over 50 feet. The following list shows a few of his final heights, corrected to Lambton's datum, with his own values of 1823–5 where available, and the latest modern value.

---

[1] DDn. 323 (48–53), 20–10–31. [2] DDn. 267 (104–13), 6–2–32. [3] *Meridional Arc* (xxviii).
[4] *GTS*. VII (xvi, 38–43—K). [5] TS. 6 (82). [6] *Meridional Arc* (clxxi n.).

Damargida	..	(from Lambton)	2026·0	..		.. (modern)	1937
Pilkher	..	.. (1823-5)	1413·5	(1847)	1441·5	,,	1333
Tek	..	.. ,,	2854·9	,,	2814·9	..	2728
Sironj Base (south)		.. ,,	1667·0	,,	1620·0	,,	1528
Usira	..	..	..	,,	900·9	,,	805
Pirghyb, Delhi		..	..	,,	913·4	,,	833
Kaliana	..	..	..	,,	917·8	,,	828
Dehra Dun Base (east)		..	..	,,	2048·1	,,	1967
Banog	..	..	..	,,	7524·2	,,	7433

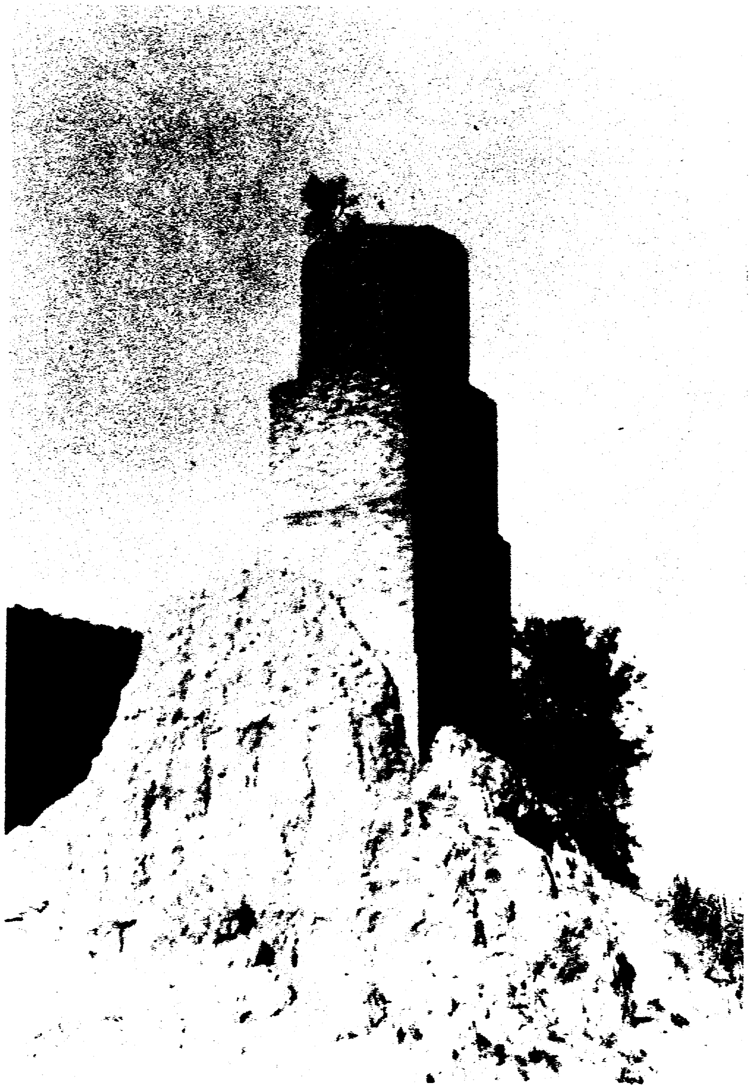
When Olliver's longitudinal series was closed on the Calcutta base-line, Everest found the height brought down from Sironj was nearly 200 feet greater than the value obtained by levelling from the Hooghly River, and he wrongly assumed this as entirely due to the inaccuracy of Olliver's work. The discrepancy was distributed right through the series, and no part to the Great Arc [58].

In discussing the values of height for the base-line towers on the Barrackpore road some years later, Waugh records that in March 1835

> a series of levels was carried between the south tower of the Calcutta base and Cossipore Ghat, whereby the height of the south end of the base was found to be 14·33 feet above the low water mark. ... The sea-level is now universally assumed to correspond with mean water, hence the height of the south end of the base is 9·33 feet. The upper station dot above the lower dot...is 73·35 feet, whence the upper dot above the sea-level is 82·83 feet[1].

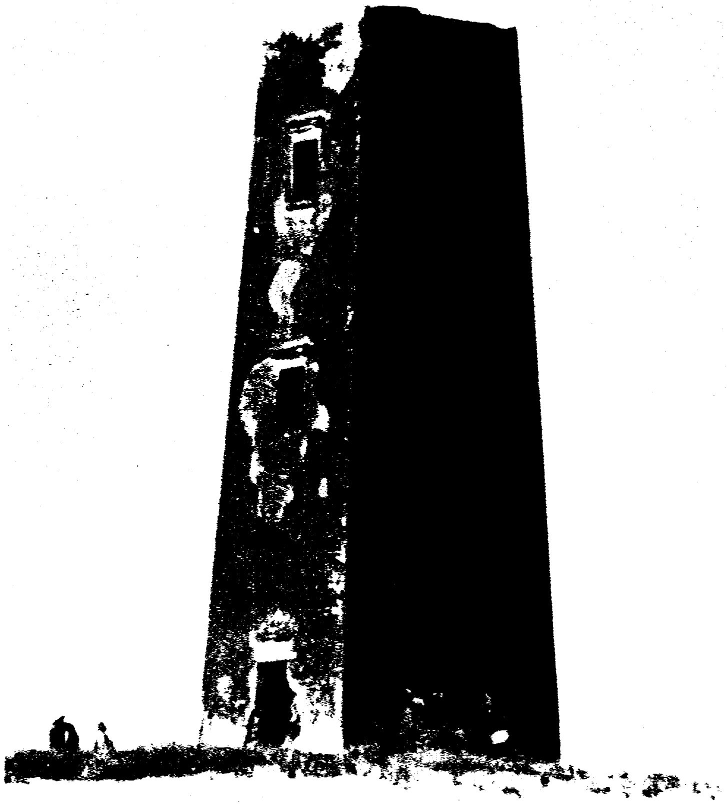
Further levelling in 1839 made the lower dot of the north tower 9·57 feet above the sea, with the upper dot 77·25 feet higher. There was considerable discussion about 1850 as to the correct manner in which to adjust these heights, and as to the true definition of mean sea-level. We do not find that Everest ever went into such matters, or concerned himself with precise heights. He left no lengthy discussions on his deduced values of height, as he did on the vagaries of refraction and other details of his work.

[1] TS. 8-1 (8); DDn. 561 (300), 1853; levelling of 1835 carried out under De Penning's direction.



TITAORA, erected 1865, 16 m. north from Meerut, about ½ m. east of Muzaffarnagar road ; 30 ft. high, with isolated inner pillar. *GTS. Trgn.* 53 G (3).

One of the stations interpolated to strengthen Everest's chain of single triangles ; *GTS.* IV (xi-A)

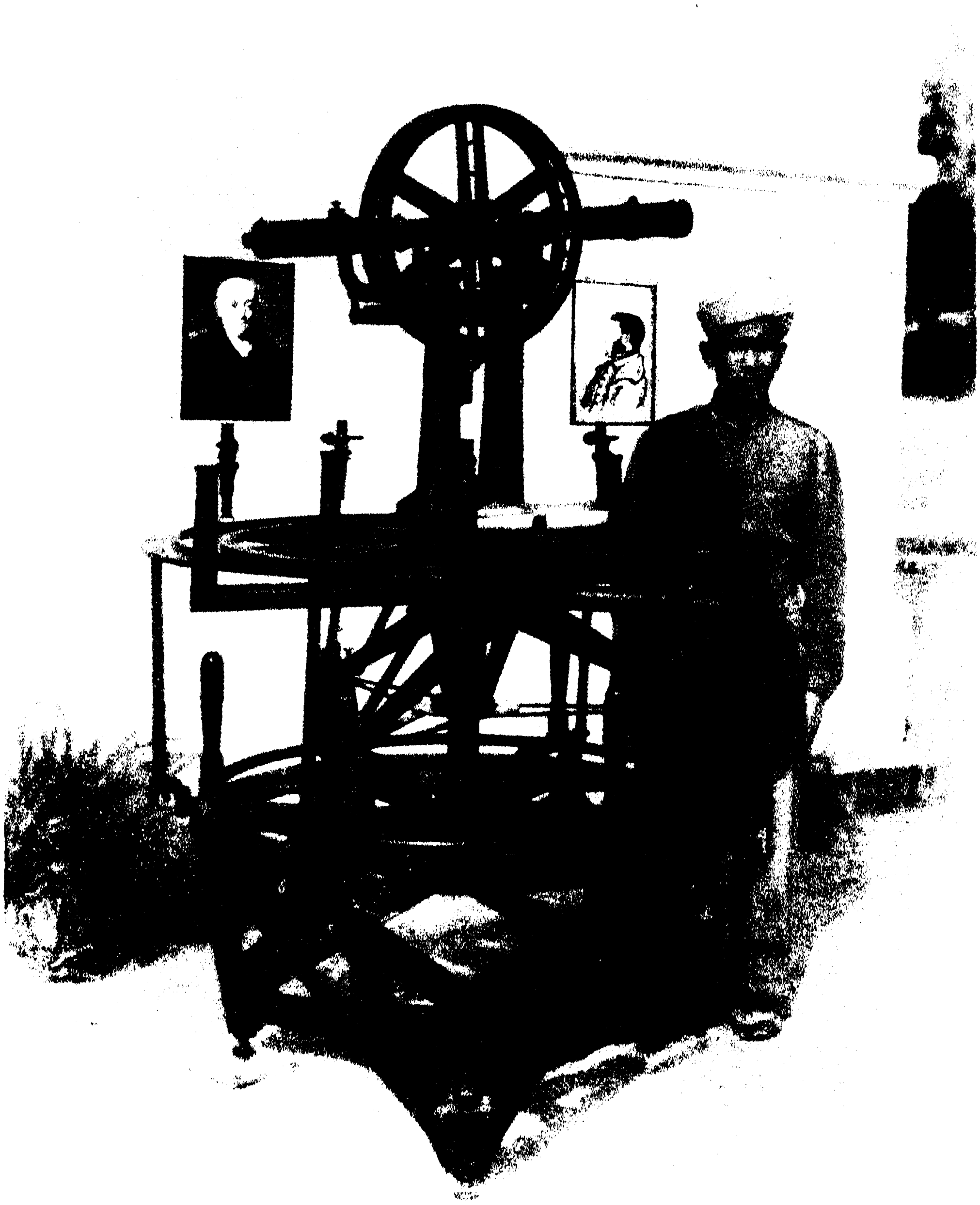


BEGARAZPUR, erected 1834-5 [ch. iii], 26½ m. north from Meerut, about 600 yds. west of Muzaffarnagar road. Of the regular pattern designed by Everest, 50 ft. high, with isolated instrument pillar carried on stone beams about 10 ft. below the top [ch. vi].

Both photographs [illegible]

Plate 6

LAMBTON'S GREAT THEODOLITE



Constructed by Wm. Cary (1759–1825); 36-inch azimuth circle.

Used by Lambton and his assistants 1802–22, and by Everest 1823–5. Reconstructed by Henry Barrow in Calcutta 1831–4, and from 1835 in constant use till 1866 [II, 253 ; III, 258–9 ; IV, ch. ix].

It is now standing in the Survey museum at Dehra Dun.

CHAPTER VII

GEODESY & ALLIED SCIENCES

Astronomical Azimuths — Zenith Distances — Geographical Positions; Preliminary Tables — Initial Elements — Local Attraction & Gravity — Refraction — Computations — Professional Reports — Great Arc Books — OBSERVATORIES; *Astronomical — Calcutta Time Signal — Madras & Lucknow — Magnetic — Tidal Observations — Meteorology — Geology.*

THE immediate task of the Great Trigonometrical Survey was the provision of points over the whole country to form a reliable basis for topographical and other surveys and maps. Measurements and observations had to be taken, and results worked out, with all the refinements of geodesy and niceties of mathematics, and with full provision for the manifold and mysterious workings of nature, and the errors of man and instrument.

The completion of Lambton's great meridional arc as the backbone of the whole system was Everest's first task, and we have described the measurements of his base-lines and the observation of his principal triangles. We have now to tell of the determination of meridian by astronomical azimuths, and the observation of zenith distances whereby a definite amplitude of arc could be expressed in linear measure. Initial values for latitude and longitude had to reinvestigated, and the ruling elements of the figure of the earth decided upon, before tables of geographical co-ordinates could be drawn up. Such are the problems that Lambton described as "still more sublime" [II, 250], and in which Everest delighted.

Observation of azimuth for the control of direction was made at the start and close of every series of triangles, whether meridional or longitudinal. Intermediate observations were also made at stations about one degree apart, and it was these azimuth stations along Olliver's longitudinal series that became points of origin for the several subordinate meridional series [58].

Intermediate azimuths were observed along the Great Arc by Waugh and Renny between 1837 and 1838, seven stations for each section [40, 42, 96]. The azimuths thus obtained were checked against those deduced from the triangles, and the means adopted. Finding that at three of the stations of the northern section, Kaliānpur to Kaliāna, the astronomical azimuths were over three seconds in excess, Everest took a further set at Banog,

> but more with the view of experiment as to the probable effect of lateral attraction exerted by the mountains...than with any idea of considering the result as verificatory. ... The principal attraction being on the north-eastern side, and the visible masses not extending beyond 5° west of north, of course the tendency would be to make the observed azimuths less than those brought up by computation, which will be seen to have occurred to the enormous extent of 20·156 seconds.
>
> Whether the error of 4⅜ seconds...noted at Kaliana has arisen from an accumulation of errors in the observed angles, or is also attributable to the same cause, it is impossible to say. I had hoped...that station...to be beyond the influence of that irregularity [104–5][1].

To determine the direction of true north, Lambton had observed his azimuths from the pole-star alone, but from 1822 Everest had included other circumpolar stars [III, 252–3], still keeping to the time of greatest elongation. After his return to India in 1830 he tried groups of observations round about maximum elongation.

---

[1] *Meridional Arc* (xliii); cf. DDn. 452 (277–97), 23-7-45.

> As, except at particular periods, only one such maximum elongation is visible during the 24 hours, several days must elapse...of unclouded sky before the completion of a set sufficiently numerous. ... I selected from the various catalogues[1]...a numerous set of circumpolar stars, all within 8° of the pole, at such convenient distances asunder that frequent opportunities might be available of observing one or other. ...
>
> Instead of limiting my observations to one per diem taken the exact time of maximum elongation, I decided that a sufficiently numerous series should be made on the star selected at or about the period of that phenomenon. ... There should be as many observations prior as subsequent to maximum, and as many face left as face right[2].

He set out the new procedure, with the necessary computations, in a paper which he read to the Bengal Asiatic Society in 1831[3], and further experience convinced him of its value. At one of his stations, in December 1836, he was puzzled by "some irregularities in the observations" and found

> that the apparent inaccuracies...had arisen from...errors of collimation and dislevelment of the transit axis, but as I had invariably taken the precaution to make as many observations Face Right as Face Left, those which were purely facial eliminated each other.

Being now entirely satisfied, he laid down a regular drill for his surveyors ;

> Observing the polar star at both elongations had often been tried...in other countries, and was a well-known method of evading...tabular irregularities. ... but it was inapplicable in India as a general practice, because the Pole Star...is not [often] to be seen with...the large theodolite under cover of a tent at both east and west points of maximum. There is, however, nothing peculiar about the Pole Star ; it is near the pole, but there are others still nearer. ... Its position is better known because more attention has been paid in observing it. ...
>
> On arriving at any station, the azimuth of some other station...is...known approximately, whereby, when the lamp is fixed, its azimuth can also be known within a small distance from the truth. By means of this azimuth, the instrument is laid approximately in the direction of the meridian for observing the transit, either of the sun or of some well-known ...star. ... When the true azimuth of the lamp comes to be known, the deviation from the meridian...will also be determined, and forms a constant correction for each time of transit.
>
> Great care is required to level the...instrument. ... Also the error of collimation is reduced to as near the truth as can be. ... Though...these two errors may be made to eliminate each other, yet it is well to know where the sources of them lie. ...
>
> The first observation is made from 20 to 30 minutes...before maximum—beginning with the lamp and reading to the star—then beginning with the star and reading back to the lamp—which constitutes one pair Face Left. The telescope is then turned over in altitude, and a pair is taken in like manner Face Right, and so forth, until there are as many face one way as face the other way, and as many before maximum as after. ...
>
> 12 hours...afterwards, the star will be on the opposite side the pole, and if the light be not too strong, a like set may be taken. ... It matters but little whether the catalogued polar distance be too great or too small, for the pole must lie midway between them. ... 4 days of clear sky are required to obtain a complete set of observations[4].

He writes to De Penning of the azimuth stations along the Great Arc [40–2] ;

> We have azimuths observed at Kalianpur, Pahargarh, Kasri, No, Dateri, Kaliana, and Banog. A set is wanted at Usira station by which means the whole length of the line will be equally apportioned into sections of 60 to 70 miles. ... Such a thing was never done or thought of before, for each set consists of not less than 96 observations—half on one side, ... half on the other—half face-left, half face right—half before maximum, and half after maximum—as nearly as can be managed. At Pahargarh there are 192 observations, at Kalianpur nearly 400[5].

ZENITH DISTANCES

Lambton took observations with his zenith sector for amplitude of arc at six stations of his Great Arc, from Punnæ near Cape Comorin to Damargida near Bīdar in latitude 18° 3′. At each of these stations he observed zenith distance to the same set of stars, and so far as possible at about the same time of year [II, 260]. At Damargida, however, he made no provision for adopting a new set of stars that could be used at stations to the north. The observations which he made at Tākarkhera some years later had to be rejected [III, 245, 253], and in taking a new set Everest had to observe new stars. He was later able to cut out Tākarkhera as a terminal station [III, pls. 17, 18; IV, 42-3].

---

[1] such as *Nouvelles Tables Astronomiques et Hydrographiques*, by V. Bagay, Paris, 1829 ; copy purchased from J. W. Armstrong, 13–9–54 ; Rs. 25. [2] *Meridional Arc* (cxli–ii). [3] *As R.* XVII, 1832 (93–106). [4] Report 3–8–39 (26–38.) ; cf. circular, DDn. 321 (274–9), 22–8–34. [5] DDn. 413 (64), 29–9–37.

As these zenith distances formed one of the most important factors of the survey [5-6, 16], Everest was determined to eliminate every possible source of error, and to arm himself with the very best apparatus and procedure. From the advice he received in Europe he decided to have two skilled observers working simultaneously, one at each end of the arc to be measured, and each with a similar instrument specially designed for the purpose[1]. These Astronomical Circles were constructed by Messrs. Troughton & Simms [131].

He thus states his problem;

> The last operation will be that of determining by celestial observation the zenith distances of a certain number of fixed stars for...ascertaining the difference of latitude, or... celestial arc of amplitude. The problem is of this kind:—
>
> If at any point on the earth's surface the angular distance of a star from the zenith, when on the meridian, be observed, and the position of that star...were known. ... the latitude of the place where the instrument stands could, if there were no refraction, be deduced...by substracting the observed zenith distance from, or adding it to, the star's declination. ...
>
> If a like operation be gone through at any other position, ... its latitude...could be deducible with equal facility, and so...the arc of celestial amplitude would be known immediately.
>
> Knowing the number of degrees, minutes, and seconds, in the arc of amplitude, as also the exact distance in feet and inches on the meridian between the same two places derived from ...the sides of the triangles, ... we should only have to determine...the length in feet of a degree in the middle part, and so obtain the constant of one of our equations.

He discusses the reasons for concluding that the figure of the earth is by no means a regular sphere, or even ellipsoid, and shows that

> the measurement of a terrestial arc in any latitude proves nothing definitive of itself, and can prove nothing until it be compared with a similar measurement in some other latitude; the greater the interval the better. ...
>
> Though the protuberant mass about the equator has a very important effect in an astronomical...view, yet it is very small...compared with the Earth's semi-diameter, ... about 1/300 of the whole. ... A vast deal of care is requisite to detect its true value, and...instruments of a superior structure...must be employed. ... The observations...require a nicety of eye and a patient attention...on a par with the most delicate operations of practical astronomy [104].

After inflicting the Secretary of the Military Department with 30 paragraphs of highly technical discussion on the uncertainties of star catalogues, the unknown laws of refraction, and other mysteries of the universe, Everest continues;

> The determination of arcs of amplitude by absolute latitudes...from the data of a catalogue is not sufficiently accurate. ... Instead of absolute latitudes, it has been the usage...to determine differences of latitude by observing the same stars at each extremity of a section.
>
> Part of the error by which the catalogue is affected will...be by this method counteracted. If the precaution too be taken of observing at the same season of the year, it is plain that errors in the aberration and solar nutation...will disappear; and, further, if the selection be made so that the stars...may be situated nearly midway between the two zeniths, any irregularities...assigned to refraction will be greatly diminished. ... This remedy is only partial. ...
>
> If at each of two places situated under the same meridian an instrument be set up at the same time, and observers at both take the zenith distance of any particular star at the time of its culmination, it is plain that all sources of error vanish, in so far as they affect the difference of latitude, except those...from refraction or...of observation and instrument...
>
> Accordingly...I commissioned Messrs. Troughton & Simms to construct two altitude and azimuth instruments, the upper circle of three, and the lower of two, feet diameter, both of which are in my charge, and when the terrestial operations are finished I purpose putting one of them at Kaliana, ... the other at Kalianpur, ... one of which, probably the latter, will be confided to Lieut. Waugh, my Astronomical Assistant[2].

Though these two instruments reached Calcutta in 1832, Everest had then no time to try them out, and it was not until 1837 that he had them sent up country, and found them so unsteady that no accurate observations could be made without substantial reconstruction, which took nearly two years to effect.

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[1] v. corr. with Colby, Salmond, and others, BM Addl MS. 14380 (72-6), June 1829; Geo Everest (2-3). [2] Report, 1836 (78-81, 84, 86, 121-3, 125-6); cf., proposals made to Directors, 8-6-29, BM Addl MS. 14380 (72).

The first arc to be measured was the northern section lying between the base-lines of Sironj and Dehra Dūn. Everest had no hesitation in deciding that the southern station of observation should be Kaliānpur, a few miles from Sironj, where he had constructed a small observatory in 1825 [III, 253]. For the northern end he first tried Karaonda 15 miles N.W. of Sahāranpur, on the required meridian 77° 41′ 45″, and just six degrees north of Kaliānpur, 24° 7′ 11″. After the measurement of the base-line in the Dūn, he sent two parties under Olliver and Murphy to select a site that could be joined up with the main triangles.

> The selection...ended in failure, after which I resolved...to fix the...the northern limit...half way between Dahera and Begaruzpur, because I should have a better chance of being out of the reach of lateral attraction from the mighty range of Himalaya [40 ; pl. 4][1].

The new site, Kaliāna, was adequately knit into the framework of triangulation during season 1835-6, and a masonry observatory built to take one of the precious astronomical circles, instead of housing it in a tent as the

> zenith sector used to be. ... Even in 1825 I had come to the resolution never to trust the latter instrument again under so feeble a protection, in consequence of the narrow escape...it had from destruction by a...hurricane at Kalianpur in February of that year [III, 253]. The Executive Engineer...is now...erecting a small building at Kaliana, for...which I constructed the pillars...in...May last [1836]. ... A similar building will be required at Kalianpur[2].

He took the azimuth of the north meridian pillar on his march south in October 1836, and told the Executive Engineer that he found the observatory

> in all respects what I desired. Two pillars are required on the south corresponding to, and exactly like, those which I erected in April last on the north side...for meridional marks. Great accuracy is required in laying them down so that the small brass head may be inserted in the middle of the upper stone of each, and truly centrical. ... If the upper stones are accurately laid by your workmen, I shall be able...to insert the brass pieces myself, and engrave the dots...as soon as the pillars have stood long enough to become dry and settled[3].

Having completed his triangles to Sironj, he found the old observatory at Kaliānpur "a complete ruin, not one stone remaining above another ; but I immediately took measures to have another constructed of more durable materials, which will probably exist for centuries"[4]. Returning to Kaliāna he found the two circles awaiting him. When he had first set them up in Calcutta, he had noticed some vibration which he attributed to their wooden tripods, which were now abandoned for the masonry pillars. To cap these he had got two stone slabs

> at Aring [40-1] from the neighbouring quarries, and conveyed them up on carts to Kaliana, where I arrived on the 24th March. ... These, one upon each pillar, were neatly...put together, and were ready on the 9th April. ... Allowing...a few days for the pillars to dry, I put up both instruments, and then it was clearly manifest that the same defect existed[5]. ...
>
> Every precaution...was carefully attended to, and...all defects which it was safe for an unprofessional person to meddle with were remedied by me with the assistance of my able sub-assistant Said Mohsin, but...there still remained an oscillation so vast as to render it out of the power of the astronomer to take an observation with accuracy[6].

Sanction was obtained for the Mathematical Instrument Maker to come up from Calcutta to make the necessary alterations. Barrow reached Kaliāna in October 1837, and Everest set him to work there before moving down to Sironj for the remeasurement of the base-line [41]. On his return in March he was greatly disappointed with the progress made, and found that his own personal supervision was essential. He took Barrow and the circles with him to Mussoorie, and by the time they returned to Kaliāna in October the reconstruction was practically complete except for the graduation of the horizontal circles. This division Barrow refused to carry out, and in February 1839 he was sent back to Calcutta and discharged [124]. Everest then entrusted this delicate task to his Indian assistant, Mohsin Hussain—the division was successfully accomplished—and the circles ready for work by October 1839 [133-4].

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[1] Narr. 1834-5 (35-7). [2] Report, 1836 (127-8). [3] DDn. 346 (182-6), 9-10-36. [4] *Meridional Arc* (xxvii). [5] ib. (xxix). [6] DDn. 344 (108-84), 3-8-39.

> Two observers, stationed at the two ends of the section were to observe simultaneously, and for several consecutive nights, each star of a selected set as it culminates.
>
> This expedient...was once tried in the years 1738–40 by...Bouguer and De la Condamine in the measurement of the arc in Quito, and failed apparently from want of concert and other bad management[1]. The enormous...difficulty seems to have deterred all future geodesists from making a similar attempt, but...my Hon'ble Masters...have deemed the plan feasible when entrusted to my hands. ... I am now remaining in India—and propose to remain—at least until I shall have shewn practically the possibility of the scheme, and carried it into effect beyond doubt or cavil. ...
>
> The arc...above adverted to...was only of 3 degrees in extent, whereas that between Kalianpur and Kaliana is of 5½ degrees, ... nearly double that in which the failure took place. ...
>
> 1st. Lieut. Waugh must be at Kalianpur with one instrument whilst I am at Kaliana with the other, and from one of these stations to the other is 38 days journey.
>
> 2nd. Commencing from a given data, ... Lieut. Waugh must observe in succession each of 24 stars as it passes the meridian of Kalianpur, and I must observe the very same stars precisely on the same night with him, as they pass over the meridian of Kaliana. ... As Kalianpur and Kaliana lie as nearly as possible under the same meridian[2], though nearly 400 miles asunder in latitude, the instant of observation to each of us will be the same. ...
>
> Not only the instruments must be in thorough order and efficiency, but the two observers must be thoroughly and entirely masters of them. ... Let the consequences of any interruption ...be contemplated. ... Let a screw get loose...which the observer does not know how to set to right ; let one of the micrometers or one of the eye-pieces get distorted—a lamp get damaged—the plumb-line break—... what then will be the certain consequences ? [124] ...
>
> The party at the other end...will continue observing in entire security and unconsciousness until he hears of the interruption, ... and as that will require several days, not only will all the observations the former has made...have to be rejected, ... but the series cannot be resumed until both parties be apprized that they are again in readiness.

Everest recalled that owing to Government refusal to allow a permanent observatory at his headquarters at Mussoorie [164], he had never been able to give Waugh or any other of his officers that constant personal training with astronomical instruments that might have provided for the present situation[3]. However, by October 1839 all was ready ;

> Lieut. Waugh will set out on the 9th October and will...reach Kalianpur about the 24th November. ... I shall despatch...Said Mohsin by dak from Kaliana on the 15th November...to aid Lieut. Waugh in putting up one of the astronomical circles at Kalianpur, after which the Said will return by dak that I may avail myself of his services at Kaliana.
>
> The instruments are now in excellent condition, but it has required all the energy that I am master of to equip the party proceeding to the southward...to march punctually to the time promised. ... My plan is systematically laid down...and will assuredly be acted up to by... Lieut. Waugh as effectively as under my own eye. ... The...observations, if no impediment arise, ... will commence on the 4th December, and terminate on the 4th February[4].

With Logan as understudy and six sub-assistants Waugh took more than six weeks to reach Kaliānpur[5]. With Renny as understudy, Everest reached Kaliāna on 12th November ;

> The instruments at both stations having been placed in position, and certain preliminary observations completed[6], both parties commenced observing simultaneously on the 4th of December. 36 stars, selected from the catalogues of Piazzi and the Royal Astronomical Society, were observed at each end of the section for 48 nights in succession[7].
>
> Until upwards of 5/6 of the whole series were completed, the nights were unusually clear and favourable, and no interruption was experienced, so that about 1,500 [observations]...are absolutely simultaneous. The remaining 1/6 were taken under...discouraging circumstances, for clouded skies of an uncommon duration occurred in succession. If these had retarded the work at both places alike, and on the same nights, it would not have mattered, but they took place at Kaliana only, so that though Lieut. Waugh's series...was finished by the 22nd January, mine was protracted until the 3rd February[8]. The difference will, however, be of no account, for the periodical inequalities are known with sufficient accuracy to enable me to introduce their requisite reductions for the short period without the slightest fear of error[9].

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[1] Gore (107–9). [2] true longitudes, Kaliānpur, 77° 38′ 17″·57 ; Kaliāna, 77° 39′ 6″·03. [3] DDn. 344 (26–36), 4–3–39. [4] ib. (267–72), 3–10–39. [5] DDn. 402 (247*a*), 7–2–42. [6] 8 stars obsd. nightly from 30th November. [7] Annual Report, 1839–40 ; DDn. 402 (214–8). [8] Waugh's ms. obsns., GBO. Lib. A–a–47 ; M. 587. [9] Everest to GG. ; DDn. 402 (247*a*), 7–2–40 ; cf. *Meridional Arc* (344–421).

His observations at Kaliānpur completed, Waugh marched south to Bīdar to prepare for similar observations at the southern extremity. A new observatory had been erected at Damargida ; "It is a very handsome and elegant building, and reflects great credit on Mr. Martin's architectural skill"[1]. At the end of the rains he made sure that the selected stars were suitable for observation so far south, and had one change made ;

> All the stars...are visible, and with one exception are beautiful objects for intersection. The one exception is...128 Tauri M, which is a faint star, and certainly less than the 6th magnitude. ... Feeling persuaded that this star would give infinite trouble, and be frequently missed when the sky was not very clear, I venture to propose...129 Tauri[2].

Everest himself reached Kaliānpur on 20th November, again taking Renny as understudy. He had fixed the 24th November 1840 as "D-day" but having a sharp attack of fever had to call on Renny to make the start ;

> Simultaneous observations...will commence tonight. During the temporary absence of the Surveyor General from indisposition Lieutenant Renny...will take the direction of the whole observations, ... precisely according to the same system, and with the same regularity, as those of last season.
>
> The opportune arrival of Captain Shortrede [So] renders the absence of the Surveyor General of less moment, and Colonel Everest wishes that gentleman to take the second half of the observations at each zero, Lieutenant Renny taking the first half. ... Mr. Principal Sub-Assistant James and Mr. Sub-Assistant Nicolson will be in attendance with Lieutenant Renny ; Lachman and Dewan Ali lamp trimmers. Mr. Deputy Computer Peyton and Mr. Sub-Assistant Lane...with Captain Shortrede ; Narsu Tindal and Persad, lamp trimmers.
>
> [Two weeks later]. The Surveyor General's health being sufficiently re-established to enable him to observe, the observations will be taken by himself and Lieutenant Renny precisely as last season at Kaliana. Colonel Everest is much obliged to Captain Shortrede for the assistance he has rendered, ... but...it is a great object that the series of both seasons should be taken as nearly as possible under the same circumstances[3].

During this second season, 1840–1,

> the number of the selected stars was 32 instead of 36. Shorter intervals were adopted on account of the increased skill of the observers, and...the whole began on the same day, 24th November, and ended on the same day, 11th January, and were...absolutely simultaneous throughout.
>
> The series taken at Kalianpur are, ... if anything, superior to those taken the preceding year by the same observers, Lieutenant Renny and myself. Those at Damargida by Lieutenant Waugh are not so good, and at the commencement presented some irregularities[4].

Everest left Kaliānpur on the morning of the 15th having entrusted the safe custody of the observatory to the Political Agent at Bhopāl[5].

He explained the technical details of his procedure in a long report to Government. Stars were chosen "so that the intervals between their times of culmination may allow of the observations to be made without hurry ; the maximum for such intervals is taken at 4 minutes". In these intervals the micrometers and the ends of the levels had to be read, and the instrument reversed in azimuth. North and south stars followed alternately, face being changed between each, in reverse order on successive nights. He describes an effective device for determination of collimation error. On an isolated pillar in front of the observatory a transit instrument was set up with its object glass directed towards that of the Circle

> when nearly in a horizontal position, and in room of the wires of the transit telescope was inserted a piece of mother-of-pearl with a very minute hole drilled in it, over which two exceedingly fine spider lines were stretched obliquely, crossing each other at an angle of 60°.
>
> This served the purpose of a fixed collimator, and, that it might be illuminated, the shutter of the aperture was closed, and a small eyelet hole was drilled immediately behind the cross formed by spider lines, whereby it might be employed by either daylight or lamplight.
>
> The beautiful luminous disk thus formed received the name of the Phantom. Three observations face east and as many face west were usually taken on the Phantom before transit of the first star, and as many after that of the last, the mean of which was used as the error of collimation for the night, and applied to the observed vertical arc of each star[6].

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[1] DDn. 378 (89–90), 21–3–40. [2] ib. (121–3), 8–10–40 ; Everest's reply, Dholpur, 29–10–40. [3] DDn. 431 (104–5), 24–11–& 11–12–40. [4] Waugh's obsns., GBO Lib. A–a–48 ; Report 1842 (100) ; cf. *Meridional Arc* (126–92). [5] DDn. 406 (9–10), 12–1–41. [6] Report 1842 (23).

The circles were fitted with oil reading lamps,

> for if the observer is to hold a lamp in his hand it depends upon the state of his nerves whether he will be able to retain it in the proper place or not whilst he is reading. ... (The most skilful observer would be unable to compete in this respect with a well fed ploughman, but a lamp-post surpasses them both). ... Each instrument had two lamps 3 inches diameter. ... Every lamp had 5 nozzles, serving to throw the light into the telescope through its axis in the usual way. The two nearest to the central nozzle served to illiminate the reading microscope of the circle, and the two exterior nozzles threw the light on the ends of the bubble of the level. Every nozzle but the central one was supplied with a small plane mirror of plate glass[1].

At his start at Damargida Waugh had been puzzled by irregularities which were apparently due to humidity whereby "the spider lines in the telescope had become ...catenarized. ... By letting in the dry air of noon, which was done as soon as the error became noticed, the discrepancy disappeared, and the instrument appeared to have righted itself"[2].

The new value for the amplitude of the arc Kaliānpur to Damargida agreed closely with that derived before 1825, but, Everest considered this "the merest good fortune", for each section of the earlier measure had obvious faults ;

> 1st., the amplitude...Takarkhera to Kalianpur ; ... all the stars...[lay] between the two zeniths, which...is objectionable — 2nd., the amplitude...Damargida to Takalkhera depended on the difference of two sets of latitudes, one...by Colonel Lambton at the former station of 1815 on one set of stars, and the other...by me at the latter station in 1824 on a totally different set of stars, ... as objectionable in principle as well can be. ...
>
> Instances of this felicitous...compensation of errors so frequently occur that some men... look on precision of principle as less worthy of regard than it merits. That is a fatal mistake and, where errors combine instead of compensating, we learn...the true value of prudence, and a rigorous attention to accuracy in principle as well as practice [III, 201 : IV, 17][3].

GEOGRAPHICAL POSITIONS ; PRELIMINARY TABLES

Before Everest had completed the field-work of the Great Arc or the subordinate meridional series [6, 11, 19], and long before he could possibly have completed the computations, he was being pressed, both by the Directors in London and the Government of India, for approximate geographical results to be used for mapping purposes, "instead of waiting the ten years required for complete verification". In July 1840 the Survey Committee at Calcutta [11, 297–8] had complained that

> the Surveyor General's Office in Calcutta is not in possession of a complete set of triangulation of the Grand Trigonometrical Survey, and as without this document it will not be possible to compile any maps in the correct manner, ... a copy of all that has already been made out should be prepared as early as possible, and forwarded to the Presidency. ... All places of which the latitudes and longitudes, or either, have been determined should be laid down, and...every other information given that can be of assistance in the compilation of maps[4].

This was passed on to the Surveyor General and, in spite of his protests, he received a peremptory order that, as no high precision was necessary for mapping purposes, he should prepare for use in Calcutta

> a statement of latitudes and longitudes corresponding with, and in continuation of, that published by Colonel Lambton for the series extending north to Bedur [III, 237, 460]. The want of such publication is daily felt, and no further time should be lost in providing that the true latitudes and longitudes, as ascertained long ago, ... be registered there, to be given to the officers employed in the local surveys, and in the construction of maps [18–9][5].

Everest was in no mood for prompt reply as he was now deeply engaged with zenith distances, and in very poor health, but De Penning felt the whole blast at Calcutta, and tells the story of

> this impatience of His Lordship and gentlemen of the Council about getting the latitudes and longitudes all cut and dry to their purpose. Mr. Thoby Prinsep of the Council[6], and member of the Survey Committee, very frequently looks into the office, seeking information about the

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[1] Report 1842 (23). [2] ib. (101). [3] ib. (105–6) : *Meridional Arc* (lxvi–lxxii) *GTS*. XI (9).
[4] from Svy. Com., 13–7–40 ; BRC. 20–7–40. [5] BMC. 7–10–40, DDn. 343 (338–55). [6] Henry Thoby Prinsep (1792–1878) Ch Sec. 1834 ; Council, 1835, 1840–3 ; BCS. *DNB.* ; *DIB.*

> construction of certain maps. I am never present during these visits, confining myself strictly to the Computing Department, ... but it has been...hinted to me "that it is very likely I shall be called upon personally, and that shortly, to furnish the latitudes and longitudes without reference to the Surveyor General, and that...a searching enquiry be made into the cause and use of the Computing Department"[1].

Everest eventually directed De Penning to take up the computation of geographical positions where triangulation results were available, and sent him instructions for revising computation formulae and forms. He himself had yet to decide on his point of departure and initial values [103–4].

He had enquiries also from James Thomason, of the N.W.P. Government, interested in the extension of revenue surveys [7, 217–8], to whom he replied that

> although the data furnished by the several series of the G.T.S. are complete as far as they go, yet they are now in process of being worked up, or computed, ... without the completion of which it is not practicable to give latitudes and longitudes. Six months hence it will be an easier matter. ... Allahabad, Indor, Aurangabad, Nagpur, have not as yet been included in our nets, and it is with them as the Chinese say—No catcher—No haver.

He gave Thomason the trigonometrical formula for computing the mutual distance between two points of known geographical position, and apologised for being "very pedagoguish"[2].

After receipt of a Government reminder of May 1841 Everest speeded up the work in his field office and in the following January submitted a list of

> latitudes and longitudes of places...to the north of Seronj. ... [I] purpose on the 1st of every month to forward a similar list of as many places as are deduced during the month passed. ...
>
> The elements thus given are not so perfect as they might have been had it been optional with me to await the completion of the base-line in the valley of the Manjera [55]. ... However, the order...is peremptory and left me no choice but to take the computations in hand with the best data which I could command. ... My earnest desire to satisfy the expectations of His Lordship in Council...will, I hope, be received as my excuse for forwarding materials which more or less partake of the nature of a premature birth[3].

A week later he writes to De Penning;

> Of the upper section of the Great Arc between Kalianpur and Kaliana 56 principal stations and 132 secondaries were sent to Government on the 3rd instant, and I have promised to send a monthly list every month, as full as I can make it. It would be a great object to get your lists prepared and sent in like manner, but, as they must...receive my signature as well as yours, ... they must come up to my office in the field. ... Do this as quick as possible[4].

The first *Tables of Latitudes and Longitudes of the principal and secondary points of the section Kalianpur to Dehra Dun* were finally checked at Mussoorie, printed in Calcutta, and copies were sent up to the Surveyor General in May 1842[5]. His fears for those preliminary values were justified, and he writes to Bedford at Calcutta;

> Several errors have been committed owing to the pressing and urgent calls of Government to furnish Latitudes and Longitudes without delay for publication, and my earnest desire to meet the wishes of His Lordship in Council. ... The more haste the worse speed. ...
>
> The computation of the triangles of projection...was assigned to two of my young sub-assistants, who from being hurried made mistakes which were not detected until the systematic computations were finished, so that in the end we are necessitated to do what I should of my own choice have done in the first instance, and I can now give you the correct data.

He explained how the more important of the errors occurred, and directed that all the longitudes published should be reduced by 2″·19, a correction that would not have disturbed the Survey Committee[6] [302].

GEOGRAPHICAL POSITIONS ; INITIAL ELEMENTS

As an essential preliminary on which he staked his professional reputation, Everest had first to decide on "the origin or starting point to which all the geodetic operations must needs be referred. ... The latitude and longitude of this origin must be determinately known, because any error in these values would ruin the whole of those deduced from them ".

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[1] to SG. 12–12–40; DDn. 307 (245–9). [2] DDn. 406 (128–9), 12–8–41. [3] DDn. 402 (226–36), 3–1–42. [4] DDn. 413 (98–101) 11–1–42. [5] DDn. 412 (73), 21–5–42; or *Great Arc Tables*, GBO Lib. F–e–59; H–j–3; by Geo. Everest; Ben. Mil. Orphan Press 1842; include such point as Simla, centre chimney Govt. HQ.; church; sketch shews the several positions of Calcutta observatory. [6] DDn. 413 (111–5), 28–4–42.

Dealing first with the longitude, he pointed out that Lambton had accepted Warren's value for Madras Observatory, 80° 17′ 21″ east of Greenwich [II, 195], and had made that of Damargida 77° 42′.

> By means of the...triangles connected therewith prior to my career, the longitude of the Damargida station near Bidar was deduced and published. In the subsequent operations conducted by myself this longitude has always been employed, and...I should not deem myself warranted in introducing any alteration in the hitherto received value of this element.
>
> [Later values] seemed...by no means sufficiently conclusive to warrant any alteration... for, just...as Mr. Taylor has assigned a new value for the longitude of Madras, some future astronomer...may introduce an alteration which will affect the geographical position of the meridian of his observatory and all places connected with it.
>
> In fact, the accurate determination of the terrestial longitude of any place is too...delicate a question to rest on a small number of observations, and if every new set of determinations were appealed to as a test, there would be no end to the shifting of the origin[1].

A similar argument had been used by Colebrooke in 1803 when he accepted the longitude of Madras as 80° 16′ 30″ [I : 181 ; II, 195]. Warren's value of 1807, 80° 17′ 21″, remained the origin for the Great Trigonometrical Survey and for all maps of India prepared by the Surveyor General, until 1905 when the latest value 80° 14′ 54″ was adopted. It is a remarkable example of his acumen that Everest should have foreshadowed in 1847 that "we may eventually, through the agency of the Electric Telegraph, succeed in the measurement of arcs of longitude". This was first attempted by the Survey of India in 1872.

He explains to De Penning that the longitude used by Lambton cannot

> be altered in one case without vitiating the whole. ... The longitude of the 1st meridian must be assumed from some data or other, for all our's are merely relative, and not absolute values.
>
> It is different with our latitudes. Our determinations of that element are absolute, and... likely to be more trustworthy than those of the Madras Observatory[2].

As regards latitude, Everest took that of Kaliānpur—"there is perhaps no place in India of which there are so many good observations for determining the latitude". He had himself in 1825 taken 388 observations on 17 well-known stars with the zenith sector, deducing a value 24° 7′ 11″·837. To meet Government's urgent call he adopted this value forthwith without waiting for final results from the observations of 1839–41.

Though Waugh had made as many as 1811 observations on 36 stars in 1839–40, and Renny and himself 1529 observations on 32 stars in 1840–41, these had been selected to suit the special programme, and included many whose positions were not too well established [99–100]. Everest preferred therefore to send this list to England that the Astronomer Royal might have the lesser known stars reobserved and catalogued at Greenwich. By 1845 he was able to work out revised results for the zenith distances of 1839–41, which gave Kaliānpur a latitude of 24° 7′ 11″·196, and this he merely noted as a satisfactory check against his value of 1825.

He had now got final values for his two arcs of amplitude,

> and it is my firm belief that there are no two elements in nature more definitively known. ... Amplitude of the northern section, 5° 23′ 37″·058 ; ... of the southern section, 6° 3′ 55″·973 ; and if the first...be added to, and the second subtracted from, the absolute latitude of Kalianpur, we hereby obtain...the most accurate value at present attainable ; ... viz., Damargida 18° 3′ 15″·864 — Kalianpur, 24° 7′ 11″·837 — Kaliana, 29° 30′ 48″·895.

He pointed out that this value for Damargida was nearly 8 seconds less than that deduced by Lambton[3]. His recommendations were accepted by the Directors ;

> We observe...that progress is now being made in the publication of Tables of latitudes and longitudes ascertained by the Great Trigonometrical Survey. We hope that no time will be lost in publishing the results of triangulation of the other meridians [102].

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[1] *Meridional Arc* (clxxii–iii) ; cf. letter to Mil. Dept., DDn. 402 (26–36), 3–1–42 ; & TS. 7–1 (11).

[2] DDn. 413 (89–91), 24–8–41.

[3] DDn. 402 (226–36), 3–1–42 (20).

> The reasons given by the Surveyor General...for retaining, for the present, the longitude of Madras at 80° 17′ 21″ East of Greenwich, as heretofore, and for altering the latitude of Damargidda to 18° 3′ 15″·86 appear to be conclusive[1].

They enclosed a memorandum from John Walker [III, 510] dated 16th June 1843 giving the longitude of Madras as 80° 14′, as derived "from corresponding observations of moon-culminating stars at Madras and the Cape of Good Hope" taken between 1834 and 1837, and combined with others taken at Greenwich, Cambridge and Edinburgh. Though this value had been accepted both by the Admiralty and the Astronomical Society it has never been used in India[2].

Besides deciding on the origin, or point of departure, Everest had to revise his formulæ for computing latitude and longitude, and decide on the values to be used for the figure of the earth. Not being allowed to wait for those from his latest observations, he adopted those which he had published in 1830[3] [III, 253–4].

> The most satisfactory method in an extensive region such as India...would be to determine the figure and dimensions of the Globe which are most compatible with the data derived from the region itself, and to adopt them finally as elements for computation of latitudes and longitudes without any reference whatever to what Geographers may think proper to do in other parts of the Planet. But to accomplish this effectually...I must have delayed the computations ...until all my data were forthcoming[4].

His final computations are given in his *Account of the Measurement of Two Sections of the Meridional Arc of India*, drawn from the material contained in MS. General Report 7, and published by order of the Directors in 1847 [44, 113].

a, the equatorial semi-diameter.	20,920,902 feet	(6378·541 km.)[5]
b, the semi-polar axis.	20,853,642 ,,	
Compression or ellipticity.	1 : 311·044	(1 : 292·4)
Latitude of Damargida	18 3′ 17″·759	(3′ 17″·35)
,, Kaliānpur	24 7′ 9″·943	(7′ 11″·26)
,, Kaliāna	29° 30′ 52″·238	(30′ 54″·70)
Longitude of Dámargida	77 42′ 31″·36 (Lambton's)	(40′ 04″·41)
,, Kalianpur	77 41′ 44″	(39′ 17″·57)

These values for the figure of the earth are described as *Everest's Constants, 2nd set* [II, 262], and have never been widely accepted. His *1st set*, published in 1830, had already been generally adopted for Indian purposes, and were sufficiently near the indeterminable truth[6] [III, 253–4].

LOCAL ATTRACTION & GRAVITY

Though Everest was at all times conscious of the disturbing influence that could be exercised by mountain masses or hidden variations of density [42–3, 95], these only appeared to affect his operations on the great central arc at its northern extremity. We have recorded his comments on the exceptional deflection of azimuth at Banog and the discrepancy of over 4 seconds at Kaliāna, the northern terminal of his arcs of amplitude [98], which latter appeared to be slightly influenced

> by the vast range of the Himalaya mountains, though it is only in very clear weather that they are to be seen, ... the distance from the high snow-clad peaks being full 120 miles. ...
>
> The southern of our two sections, Kalianpur to Damargida, shews rather more consistency when compared with arcs measured in other parts of the Globe, but its deviations have an opposite tendency to those...of the northern. ... There is no visible cause to suspect local irregularity of attraction, and if I were required to point out two spots on the earth's surface utterly free from that defect, I know not two others to which I would give the preference. ...
>
> My opinions of the section Kalianpur to Kaliana...are quite on a par with...the section Kalianpur to Damargida, but there is room to apprehend that the northern limit, Kaliana, has been influenced to a greater or less extent by the lateral attraction of the Himalaya Range[7].
>
> [He discusses the best way to disperse] the difference between the computed and observed amplitudes. ... It is in vain to say to what cause such discrepancies are attributable. No terrestial measurement has yet been free from them and probably none ever will be.

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[1] CD to B. (Mil), 26-9-43 (37-8). [2] cf. *Meridional Arc* (clxxiii n.); Markham (66); *Great Arc Tables* (24). [3] Geo. Everest (115, No. 2). [4] Report 1842 (198). [5] in brackets Survey of India values, 1927; Hunter (12). [6] *Meridional Arc* (clxxvi–ix). [7] Report 1842 (217–20).

> In the section...Kalianpur...Kaliana the difference is 6″·427, which is subtractive from the computed value. The probability is that the greater part of this...has been caused by the lateral attraction of the Himalayan range, ... in which case it would very nearly inversely as the square of the distance from the centre of the gravity of the mass, but the computation of this would be a serious task to grapple with, and...Government should be fully...prepared to sanction the measure, with all its comcomitant expense of time and money [95, 98].
>
> In existing circumstances this is not to be looked for, and the only way...is to consider the discrepancy generated equably[1].

Everest had, therefore, deliberately avoided observations for latitude that might be subject to local attraction. Such considerations did not however weigh with Shortrede who, during his stay at Dehra in 1841, made a series of observations for latitude, on his own initiative, at a point "about 100 feet due west of the chimney of the Surveyor General's office[2]. He deduced the excess of computed latitude over the astronomical to be 30″·76[3], which agrees closely to that now accepted.

Both Lambton and Everest appreciated the value of pendulum observations for the investigation of variation of gravity, but had no opportunity to put them into practice. In an indignant reply to Thomas Jervis' remarks on the lack of such observations in India, Everest describes his study of the subject during his visit to England, and a paper he had written in 1829[4], which had inspired Edward Troughton to start work on a pendulum of his own design.

Apparently on Kater's suggestion, the Directors had already ordered "two invariable pendulums. ... constructed by no less celebrated an artist than Mr. Jones of Charing Cross, ... exactly like those used by Captain Sabine" [III, 254]. In 1830 these "magnificent instruments" were "for upwards of twenty days...open for actual inspection...in the suburbs of London before their despatch to India". He was himself, writes Everest, responsible for

> the omission of pendulum experiments, for the implements are actually at my...command, and have been since 1830, and all that...has been wanted is the *personnel* to put them into action. ... Pendulum experiments cannot be superintended by me because I have too many calls on my time. The person who is to execute them must learn his business, and learn it well too, or I will have nothing to do with the matter. ...
>
> The two pendulums will remain in quiet repose and preservation until the time arrives when I can...honourably retire, and leave my successor to occupy my vacant seat[5].

REFRACTION

An account has already been given of Everest's first experience of the vagaries of terrestial refraction, whereby a distant point which is entirely out of sight during the day may become clearly visible after dark, provided there is a lamp or fire to mark its position [III, 235]. He took every advantage of this daily phenomenon when working his triangles across the flat tree-covered *doāb* north of Delhi, and has left vivid notes of the strange tricks of atmosphere that worried him between one station and another [33–6, pl. 4].

> Nojhili to Godhna ... On the final work in November 1835...there were several obstructions which, though they did not affect the...ray after midnight, effectually impeded it by daylight. It passed over five villages...in which several houses...and haystacks stood in the way. These were removed, ... after which the disk of the Godhna heliotrope made its appearance very late on the evening of the 25th November. It was then obviously rising very rapidly. ... When seen it was at a depression of between 7 and 8 minutes, and had probably risen 2 minutes, thus standing at the time of minimum refraction at a depression of 10 minutes.
>
> At 3 hours 55 minutes after midnight on the 25th November[6] the Godhna lamp stood at an elevation of 2′ 55″, and on the 27th November at the same hour, at a depression of 18″, thus shewing a discrepancy...of 13 minutes or more between the after noon and after midnight refraction, and an uncertainty...of 3′ 13″...at the same hour. ... The vast difference...between observations made at the same hour without any visible cause baffles all computation.

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[1] to DSG., 5-5-42; DDn. 406 (249–50). [2] in Old Survey Rd. [3] *RAS*(*mn*). VIII, 1845 (189–91). [4] ib. 1 (118); *Trans. RAS.* (1829–30). [5] Everest (57–62). [6] for many reasons Everest preferred nights obsns.

The distance Nojhili to Godhna is...23 miles, and an arc of 3′ 13″ would be equivalent to 114 feet, to which amount the difference of height...would be uncertain.

Nojhili to Dahera. At Nojhili on the 27th November 1835, at 8 a.m., the phenomenon was first noted of the heliotrope assuming the columnar form, in which...that of Dahera shewed itself tall, slim, and erect. The same...has since occurred so frequently as to have become a matter of common notoriety, but one of the most remarkable instances...is that of Karaonda, a station which I once had thoughts of using as the northern extremity of the section [98]. ... It resembled a conflagration, and had the appearance of an enormous blazing pile, being extended laterally as well as vertically.

Begarazpur to Saini. Begarazpur...is a station on the summit of one of the sand mounds so common in the Doab, and is close to the high road leading from Meerut to Muzzafarnagar [pl. 5]. ... The tower...is 50 feet high. ... The...ray...to Saini, 23·8 miles, is one of great difficulty. In the approximate series with my instrument on a scaffolding 30 feet high at Saini, and a mast 90 feet high at Begarazpur, the blue lights burned at top of the latter were observed by me at 6½ hours in the afternoon of the 11th March 1834, and also at 4½ hours after the same midnight. ... Not a tree was then cut, so that though several lofty pipals stood in the course of the ray it must have passed clear of them all.

Subsequently with a mast of 70 feet at Saini, and my instrument on a scaffolding 30 feet high at Begarazpur, I observed the blue lights burned at the top of the former at 4 hours after midnight of the 19th March. ... I had...sent out a party to effect a clearance, but at 4 hours after the next...midnight, the Saini blue lights were most distinctly seen, not only by myself at the...top of the scaffolding, but by Lieut. Hill...who had taken part with a hand-telescope several feet below ...

I formed my estimate that two towers of 50 feet would suffice, ... but in the final series, though I felled every remaining tree, and even dug down the mud mound of the old fort at Maovi, besides removing two thatched houses...which stood in the way, yet between the 11th and 26th December...not one instance occurred of the Saini heliotrope appearing. Even blue lights burned soon after sunset were not seen, which can only be attributed to the irregularity of refraction. ...

The horizontal angles were eventually finished with blue lights burned at 2 to 4½ hours after midnight of the 25th December. ...

The most extraordinary part...still remains. ... When I removed the large theodolite to Saini in January 1836, the Begarazpur heliotrope was seen...rising above the ruins of the mound of Maovi...on every evening from the 4th to 11th January, and this with so much punctuality that its...appearance at ½ an hour before sunset was...of almost certain occurrence.

Sheopuri to Saini. 22·7 miles. ... The heliotrope is for the greater part of the day obscured, and cannot be seen at time of minimum refraction. This is the more remarkable because in the approximate series I observed all the angles...without a scaffolding, the instrument...standing on the surface of the mound. The angles with Saini and my referring lamp were observed from 6½ to 7 in the afternoon of the 21st March 1834, when the first of four blue lights...burned at top of a 70 feet mast was seen grazing the side of a high intervening tree, just as if it were a ripe fruit growing on the branches.

In the final series that tree and every other which obstructed were felled, a hut was removed in the village of Paharpur, and a deep trench cut through a sand mound at Raoli, yet the heliotrope seldom rose before 5 in the afternoon, or was visible later than 7 in the morning[1].

Though these vagaries of refraction did not affect the accuracy of horizontal angles which could await favourable opportunity, Everest realized that vertical angles required special precautions.

Between 3 and 4 p.m. is the hour of minimum, and the same hour after midnight is the period of maximum refraction. Though as a general rule this still holds good yet the deviations...are so vast and manifold as to frustrate all attempts to apply practically. ...

In some instances in the month of January the image of the distant heliotrope had its periodic hour of rising before sunset, but was never seen at any other hour of the day. In the months of March and April, however, the heliotropes at sunrise, and for sometimes an hour after, were seen projected high up on the sky, and frequently in the form of a tall column.

The afternoon rise of the distant heliotrope is curious and beautiful. The first rays spread themselves like a running fire along the surface of the obstructing land, ... the light then descends and re-ascends, till after a few oscillations it ultimately rises into a clear round disk, and remains visible till the rays of the sun become too feeble for reflection.

---

[1] Report 1836 ; Description of stations.

> The descent in the morning is equally remarkable. In favorable weather the round disk appears immediately subsequent to sunrise, projected high up in the sky, *and* after...a short time it gradually descends...or...suddenly vanishes as if by an explosion.
>
> There are two methods of overcoming this irregularity, the one...in the ordinary process of levelling, and the other in taking the vertical angles simultaneously.
>
> If two instruments be placed, one at each station, at the same time, each having a heliotrope or lamp, ... and, whilst the observer at one station is engaged in observing the other station signal, the latter observes that of the former, the reciprocal angles must be taken exactly in a similar state of the atmosphere, ... equally affected by refraction.
>
> I purpose to try the latter, as the more expeditious and elegant, and—in the event of its failing—to resort to the former, which is the slower and more homely method[1].

These simultaneous reciprocal vertical observations were carried out under Waugh's superintendence during May and June 1837 when the observers were continually tantalized by these strange phenomena [41].

Everest advises Jacob how to deal with such strange disturbances ;

> Every observation is made...through a medium of very uncertain consistency and variable temperature. ... The smoke and...vapours which are perpetually rising from the earth have palpably not an uniform density at a given height above the surface, and the ray...must...be liable to lateral as well as vertical refraction. ... The small disk of the reverboratory lamp, which is only 12 inches in diameter, and in a clear...atmosphere is reduced to a luminous point, swells out sometimes...into a broad ill-defined disk subtending...2 minutes of the horizon, *and* vibrating more like a sheet of fire than an object intended for accurate intersection, while the visible disk of the heliotrope, ... an aperture of 2 inches diameter, is even wilder.
>
> The only method of overcoming these...irregularities is to await a favorable state of the atmosphere, and be prepared to profit by every such opportunity which...occurs...almost every sunny day...between 4½ o'clock and sunset. ... Sometimes...the lamp is beautifully adapted to intersection from sunset till past midnight, or even later, so that the patience has to be tried, though not to the extent...requisite when...opaque objects were the only marks. ...
>
> The state of the atmosphere immediately after sunrise...is rarely to be depended on ; ... the disk of the heliotrope then often shows small and round...near the horizon, like a candle shining dimly through a hole in a curtain, but, even whilst the observer is...intersecting this object, another image exactly similar to it rises to the right or left, above or below, after which the first disappears, thus puzzling...the eye with...the crazy wanderings of an ignis fatuus. ... The only possible way is to give up observing for the time being, ... until after the noon-day sun has thoroughly warmed the earth. ...
>
> There is however, a case wherein a lateral deviation seems to be produced permanently, ... when the ray grazes over an uneven surface. ... The ray is liable to be deflected from the sloping side, ... the effect of which is to produce an error against which no prudence can guard. ... Its tendency will be to make both the other angles vary by a quantity either positive to both, or negative to both, according to the direction in which the deflection operates, and...as the refractive power of the atmosphere wanes...the effect will also be variable[2].

COMPUTATIONS

On his return to India in 1830, not only had Everest to make provision for the regular computation of the work that lay ahead of him, but he had also to work off the arrears that had been left behind in 1825 [III, 238, 256–7]. The account which he had published at home in 1830 had covered the section of the Great Arc from Bīdar to Sironj, but not having been prepared from the original angle-books could not be considered final, though the results it gave for the figure of the earth gained world-wide recognition as ***Everest's 1st Constants*** [III, 253–4 ; IV, 104].

> There are arrears of calculation of very long standing which ought, years ago, to have been completed. ... The 5th and 6th volumes of the General Report were left incomplete at the time of Lieut. Colonel Lambton's death. These should now be put into an entire state so that one copy may be lodged in the India House, and the home set perfected up to the period of 1822 [III, 237–8]. It is also...of great importance...that the computations of the series on which I was engaged in 1822–23...should be brought to a conclusion [III, 234–6]. ...

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[1] Report 1836 (55–8) ; cf. *Meridional Arc* (xxviii).

[2] DDn. 325 (179–235), August, 1840.

> The data for the principal triangles of the Great Meridional series between Daumergidda near Bidar and Kullianpoor near Sironj were all taken by me to England in 1825–6, and the computations...made under my superintendence printed at the expence of the East India Company [III, 246, 256–7 ; IV, 112–3]. But there are...some hundreds of secondary triangles and barometrical observations connected with that work which still remain to be calculated. ...
>
> The computations of the eastern series on which Mr. Olliver has been engaged during my absence are necessarily in a very backward state...because that party was generally in the field for 9 months of the twelve, and during the remaining 3 months...the sub-assistants...were totally disabled by severe and continued sickness [III, 257, 264][1].

For this work Everest secured the services of Joshua De Penning who had for so many years been Lambton's right-hand man [III, 379–80, 437–9], and recruited a number of Bengali students [337–9]. By December 1832 he submitted

> two copies of the 5th and 6th volumes of the General Report...and one of the plans. ... This work...now comes forth as the first fruits of the new computing establishment. ...
>
> One of the copies and the plan are...for...the Hon'ble Court of Directors. The other copy, and one of two plans now in...preparation is intended for deposit in the office of the Surveyor General. A third copy, with the other of the two plans, ... will remain with the office of the Great Trigonometrical Survey[2].
>
> The whole of the computation have been gone over by two individuals, acting independent of each other. ... The results...have been written out by Mr. De Penning, and afterwards copied, either by writers hired out for the purpose, or by some of the computing youths. The copies... have been on two different occasions compared with the original by two persons. ... All human works are liable to error, and it is only in the power of man to guard against its intrusion by care and attention [III, 237 ; IV, t-page][3].

Whilst Everest himself, with the assistance of Peyton, Deputy Computer, and Radhanath Sickdhar, the star of the students, carried out the current computations of the Great Arc, computation of arrears and of subordinate series were taken out at the Calcutta computing office under De Penning, who was responsible for producing the manuscript general reports in the required form.

Each field surveyor was given "extracts from the General Reports...shewing the manner in which the sections and paragraphs have hitherto been arranged". Their results were to be submitted regularly to the Surveyor General "systematically drawn up" [338] ;

> 1st. Angles observed at each principal station — 2nd. Principal Triangles — 3rd. Description of each great station — 4th. 5th. 6th., Secondary triangles of the 1st, 2nd, 3rd class — 7th. Elevations, depressions, etc.
>
> Secondary triangles of the 1st class are those of which two points are at principal stations ; ... of the 2nd class are those of which two or more points are dependent on secondary stations. It has not been usual to introduce into the General Reports triangles taken with a small instrument, but I shall adopt such of those...as are worthy of confidence to within 40 feet and these will be secondary triangles of the 3rd class.
>
> In regard to observations for azimuth, ... it has hitherto been usual to take the star only at its greatest elongation, whereas your observations...will require a correction for the difference of time. I have arranged a new table, ... and I also enclose a specimen of the mode in which I wish the actual observations to be inserted in your angle books [96][4].

From time to time changes were made in the formulæ. Most of the forms were lithographed, and as De Penning could not get "perfect impressions from the Government Lithographic Press" he preferred "preparing the skeletons in the office with the aid of the extra draftsmen [312]"[5].

After the move of the Deputy Surveyor General to Allāhābād in 1833, De Penning became the Surveyor General's representative at Calcutta, and computations were constantly delayed by other "multifarious and harrassing duties". At length in 1838 Everest forwarded to Government De Penning's "most disastrous and lamentable accounts of the dilatory progress of the computations", and asked that "my Chief Computer should confine himself to the performance of the duties for which he and the establishment were originally appointed"[6]. He made at the same time an earnest plea for his own relief from routine administration which distracted him from professional work [34, 315–7];

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[1] to Mil. Dept. 4–2–31 ; DDn. 265 (147–53). [2] Two copies each, TS. 6 ; GBO Comp. G–5, 6 ; GBO Lib. H v. 19. [3] to Mil Dept. 13–12–32 ; 283 (235–8). [4] DDn. 321 (274–9), 22–8–34. [5] DDn. 352 (179–81), 30–6–38. [6] DDn. 342 (164–5), 11–5–38.

> Even after the materials are all collected, but in their unworked state, a vast deal of skill, arrangement, and method, is requisite to deduce the results. ... Even after the materials have been all worked up and the results obtained, it requires these qualities in at least an equal degree to reduce them to order, and describe the methods used. ...
>
> It is impossible for any person, however highly gifted, to execute a task of the kind...whilst his attention is liable to be distracted by office routine duties. We have it under Sir Isaac Newton's own avowal that he was himself unequal to the business of computing correctly unless when totally free such distractions. ...
>
> The recent operations [Great Arc] can never be so well arranged in a shape fit for publication as now, whilst they are fresh in the recollection of myself and other living parties, nor will there ever be found a person more zealously disposed than myself to do justice to the subject. It has occupied my waking and sleeping thoughts for years. I have borne sickness, privations, and hardships, such as fall to the lot of few men...without a murmur. I have been marked out over and over again by medical men as the certain victim of death [III, 244 ; IV : 5, 53, 316].
>
> I have organized the means, personal and material, by which the work has been conducted, the former having all been trained entirely by me, whilst of the latter...many have been invented and designed, by me. Many of the most important formulæ and methods owe their origin to my investigation and, whether they be new or old, all the most efficient of the present race owe their...acquaintance with them to my tuition. ... It never could be expected of me that I should...arrange a work of the kind without sufficient means ; without sufficient leisure from the tormenting and harassing routine of an office [343–5]. ...
>
> No step whatever has yet been taken in arranging the materials...in a shape fit for publication. ... I have been unable to...exercise the supervision which I deem necessary over the computations which have been conducted since my return to...Dehra on the 8th April last, for want of leisure, and...if those computations contain errors and require to be gone over again, it is not my fault. ...
>
> I shall be unable to perform conscientiously the duties which ought to be exercised by the Superintendent of the G.T. Survey, until an efficient Deputy is appointed to relieve me from the drudgery of office routine [324]. ... The work must be arranged, either in India or England, in a state fit for publication[1].

As a result of this appeal the Deputy Surveyor General, who had already been moved from Allāhabād to Calcutta for charge of revenue surveys [322], was now directed to assume also the charge of the Surveyor General's offices at the Presidency, leaving De Penning to his computations [325]. At the same Everest was given an officer assistant for charge of his field office [326–7].

Among the many new formulæ and computation forms introduced by Everest were those for computing azimuths from circumpolar stars [96]. In De Penning's first set-up of the forms, Everest found

> the arrangement of the tables was insufficient in some parts, and in excess in others. ... These are faults entirely of mine. ... As the formulæ are all very beautiful and elegant, I hope you will...make a neat and speedy job of it for me, for by the help of them we shall be able with great ease to compute all our azimuths[2].

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He devised new forms for recording vertical angles and deducing heights[3], and reduced the computation of "latitudes, longitudes, and azimuths to as compact a form as it will admit". He warned De Penning that "the secondary triangles were only to be computed to the nearest second ; we have not time for these minute calculations".

Possibly the problem that exercised him most was the dispersal of errors amongst the triangles of a polygon or larger series, on which he wrote several long notes[4].

> The new set of equations...were devised by me for the purpose of accomplishing the same harmony amongst the sides, which has hitherto only been sought for amongst the angles. ... For several years past all my officers...have had copies of these formulæ, illustrated by examples, ... required in principal triangles. ...
>
> They furnish a determinate mathematical rule for disposing of small errors which must be got rid of, ... and thus take away all excuse for that most objectionable pretence of charlatanry

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[1] DDn. 342 (202–13), 11–6–38. [2] DDn. 413 (64), 29–12–37. [3] DDn. 321 (274–9), 21–8–34.
[4] DDn. 324 (281–4); 325 (179–230); Report 1842 (173–84).

> called..."judicious selection", but which is in reality neither more nor less than arbitrarily altering the data to suit the views of the party having recourse to it [III, 252 ; IV, 90].
>
> The methods...have been employed with great success in the computations of the Great Arc and Calcutta Longitudinal series, as also...all the subordinate series emanating from the latter. They have likewise been used by Lieutenant Jacob in the Bombay Longitudinal series, and, as they never fail to improve the triangulation, ... the system of polygonal figures has been introduced into meridional series of late years in lieu of the single series of triangles[1].

He warns De Penning against the evils of arbitrary adjustment ;

> Of all these matters notes must be made in the General Report because there is no objection to using any method provided it be candidly and honestly applied. The fault is in cooking and dressing in secrecy, and giving the world to understand that such practice was not resorted to. This is the underhand proceeding to which the term charlatanerie is is applied[2].

De Penning had difficulties with Olliver's longitudinal series [18–9, 58] ;

> We lost much valuable time while computing the corrections for the polygons owing to a serious error in Hutton's Table of Products[3] which we use, ... and this was not discovered till we had nearly completed the corrections for one of the tedious figures. Of course we were obliged to recompute the series. ...
>
> I am now engaged in revising the triangles near the Calcutta Base Line, for I find two sets of angles recorded in the angle books, ... and no reason assigned. ... Moreover...the angles used in the triangles are only those that give the least error. ... I am now taking the mean of the two sets, ... by which I am in hopes of reducing the error in the base-line to one half of what it was before. But it will entail...much time for recomputing[4].

De Penning was at a considerable disadvantage in that he was responsible for the final work without having any chance of personal discussion. For more than ten years his only contacts with the Surveyor General were by correspondence. There were difficulties with computations of the Amua Series, and Waugh, as Astronomical Assistant, was not sympathetic ;

> You...recompute the whole just as if you were master, to employ the computers how you like, and as if there were not a shorter method whereby all this labour might have been saved, a method of which the Chief Computer ought not to be ignorant, seeing that it is familiarly known to every sub-assistant. ... The Surveyor General...before he left Calcutta presented you, for the use of the computing office, with a copy of the very paper in the 18th volume of the Asiatic Researches of which you plead ignorance. ...
>
> The Surveyor General...has instructed Mr Principal Sub-Assistant and Deputy Computer J. Peyton to draw up for your...guidance such forms of computations as are unknown to you. ...
>
> The following recomputations will be necessary. ... The sides of all triangles...will require to be altered in the ratio of the values formerly used and those now introduced. On account of the circumpolar...observations at Ramespur having been gone over by one person, they will require to be recomputed in toto by the approximate formula...furnished by Mr. Peyton. ...
>
> On account of the latitudes, longitudes, and azimuths having only been gone over by one person, and the 3rd and 4th parts omitted, they will require to be recomputed in toto. ...
>
> On account of the variation in the height...of the origin, all computed heights thereon depending will require to be corrected[5].

The comprehensive formulæ and the regular system of his geodetic computations were amongst the valuable bequests that Everest left the department. They were in the safe keeping of his three trusted pupils, Waugh, Peyton, and Radhanath Sickdhar, and under Waugh's direction Radhanath compiled the first edition of the *Auxiliary Tables of the Great Trigonometrical Survey*, 1850.

PROFESSIONAL REPORTS

Whilst Everest kept Government constantly advised as to his progress, he also submitted brief annual reports for all his field parties[6]. These did not go deeply into professional details, which he kept for his special triennial reports, the first of which was dated 30th August 1836[7]. It covered 178 paragraphs and three appendices and described all the work on the Great Arc from his departure from Calcutta at the end of 1832, including the measurement of the Dehra Dūn base and the observation of the triangles north of the Chambal [39].

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[1] DDn. 324 (176–84). [2] DDn. 413 (47–52), 18–8–40. [3] *Mathematical Tables*, Chas. Hutton, 1st edn., RMA., Feb. 1785 ; 5th edn. May 1811 ; 7th edn., further improved, Olinthus Gregory, RMA., March 1830. [4] DDn. 307 (257–8), 3–2–41. [5] DDn. 453 (73–5), 9–8–43. [6] eg. season 1833–4 ; DDn. 286 (165 *et seq.*) 1–11–34. [7] Report 1836 with Narrs. 1833–4 & 1834–5.

The second, of 104 paragraphs, was dated 3rd August 1839. and described the triangulation down to Bīdar, the measurement of the Sironj base-line, and the reconstruction of the astronomical circles. A supplementary report dated 21st August described the closing of the Calcutta Longitudinal Series, the four subordinate meridional series, and the large theodolites[1].

The third, of 245 paragraphs, dated 13th August 1842[2], brought the Great Arc to a close with observations for zenith distance, the measurement of the base near Bīdar, and final computations and deductions.

One copy each of these reports went to the Directors, who thereby got full technical explanations of the principles on which Everest was working—vivid accounts of the difficulties he overcame—and clear discussions on future programme.

These were narrative reports giving no numerical results, for which Government was impatient [101–2]. Everest explained that his final professional "General Reports" with full detailed results could not be hurried ;

> The 5th and 6th volumes were...sent...for transmission to the home authorities in December 1832, previous to my departure from Calcutta [108]. ... It has been my intention to arrange the materials amassed subsequent to that period into another volume, as soon as sufficient correct data shall have been accumulated. ...
>
> It never was the practice to complete such reports whilst the operations were in progress. ... When the materials are accumulated in sufficient quantity, a twelve-month's cessation of field operations at least...will be necessary to enable me to complete...such a volume, but, ... so unremittingly has the field duty been pursued, that the utmost attempted has been to work up the different observations made in the preceding season. ...
>
> Nothing whatever should be admitted into the next General Report except what is likely to need no...revision. ... Parts of the work...(viz., the celestial arc of amplitude between Kalianpur and Damargida, and the base-line in the valley of the Manjera [55–6]...) yet remain. ...
>
> In all trigonometrical operations a complete map or plan is the last portion of the performance, and ought never...to be taken in hand until the whole of the topographical materials have been worked up, so as to give the utmost amount of worthy numerical data. ...
>
> The volumes of the General Reports...are...a record of the numerical data...to form the elements of the topographical maps. ... Matters more purely scientific, ... relating to the higher branches of the profession, ... are usually accompanied by an introduction...and by explanations...of the methods employed, and the circumstances under which...conducted[3].

Government, however, pressed for tables of geographical positions to be supplied at once, and much against his will Everest set to work to determine exact values for his points of departure, and put in hand the preparation of these tables which were published in May 1842 [102].

The final General Reports, 7, 8, and 9, were only just complete before he left India, containing full computations and results, and historical narratives. Each Report volume included a copy of the appropriate charts ; those of the Great Arc were prepared with special care, and showed all secondary and minor work[4].

Volume 7 covered all operations of the Great Arc, and was prepared for the most part under Everest's immediate control at Dehra Dūn and Mussoorie[5].

Volume 8 covered the Calcutta and Bombay longitudinal series, whilst

Volume 9 contained the work of the Budhon, Ranghir, and Amua series[6].

Two fair copies besides the originals were made, and Everest could not agree to a Government suggestion that—to save the expense of copying—his original should be kept open for general reference at the Presidency ;

> As there is but one copy of the original documents of the Great Arc series, they cannot ...be lodged both in the office at Calcutta, and in the archives of the India House. ... The authority of all scientific works—and geodetical operations perhaps more than others—is greatly

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[1] Reports 3/21–8–39. [2] Report 1842 ; Govt. gave copy to ASB. which abandoned proposal to print it ; *JASB.* xi, 1842 (1199). xii, 1843 (251) ; xvi, 1847 (99). [3] DDn. 402 (57–81), 24–7–40 ; paras 29–31. [4] Great Arc charts, *IO Cat.* (33–4) ; *Meridional Arc*, pls. 31–2. [5] TS. 7, *IO Cat.* (12–4) ; GBO. Comp. A/23, G–5/7 ; *JRGS.*, 1844 (cv–cvi). [6] *IO Cat.* (14–5) ; TS., 8, 9.

> enhanced by the preservation of the original documents, ... so that if any accident should occur whereby this single copy should be lost, mutilated, or injured in part or in toto, the value of the extracts from it...will be materially lessened. ...
>
> The next volumes of the General Report will contain matter of much moment to the geography of India. ... There are some thousands of principal and secondary stations, and the great ...anxiety with me is to put the materials into such a state...as will admit of the work being... completed by my successor, even if I should be unable to finish it before I leave India[1].

He devoted his last two years entirely to these computations and reports ;

> It is manifestly to my interest that nothing should remain incomplete, and every hour has ..been devoted to this object, both by my computers in Calcutta, and my assistants at Dehra. But there is such a mass of matter to be reduced to order, and copied fair, and so much time ...has been unavoidably lost in marching. ... In marching everything has to be packed up with care, and...office duties rarely begin before 12, and only then in short marches. The mechanical habits of computation become unhinged...from a long journey.

It was for this reason that he abandoned his intention of joining in the base-line measurement near Bidar [55–6][2].

While the general work on volumes 8 and 9 was done in Calcutta under De Penning[3], much was retained at the field office at Mussoorie, and during the recess months put under Waugh in his capacity as Astronomical Assistant [316, 356]. There was great pressure of work in the summer of 1843 before Everest left India

> to have the 8th and 9th vols....brought to a completion before the several parties...disperse for field operations. I have set all hands busily at work towards the accomplishment of that end. ... Additional aid is indispensable, ... and I have therefore taken upon myself the liberty to order the temporary engagement of the requisite number of extra copyists [378–9]. ...
>
> Parts 1st and 2nd, volume 7th...are sufficiently provided for, ... and would be ready for transmission, but for the examination of the plans which is now in progress[4].
>
> [A month later]. My civil establishment are all assiduously occupied in reducing to order the fieldwork of the last season's labours, and arranging the materials for incorporation in the 9th volume of the General Report. It is an object which I have much at heart to have this volume sent to the India House in a complete state before I quit India, so that my successor on receiving charge of my Department may find it clear of arrears.

He suggested the 15th September for starting for the Presidency, "by which date there is every reason to hope that...the 9th volume of the General Report will be completed"[5]. Office was actually closed at Hathipaon on Saturday, 16th September, and moved to Dehra during the week-end. Computations were kept up throughout the six weeks journey down the river and finished off in Calcutta before Everest's departure [174].

GREAT ARC BOOKS

Everest's first Great Arc book, published at the expense of the Directors in 1830, had covered the work of the Great Trigonometrical Survey from the time of his joining Lambton at the end of 1818 till his departure on leave in 1825 [III, 256–7]. Its great historical interest is the introductory narrative rich with personal colour. It gives particulars of the Great Arc between Bidar and Sironj, but was only preliminary to the final manuscript General Report, volume 6, which Everest signed as completed in 1839.

Everest was much distressed at the short supply of copies, the Directors having cut their original order when reading in his preface that its contents were not complete and final [107].

> Five hundred impressions were struck off, of which the Chairman assigned to me 40 copies besides the proof impression. ... I sent 11 to Baron Humboldt [II, 44 n.5] for...scientific gentlemen on the continent ; 27 were presented to scientific ladies and gentlemen of my acquaintance in England, and I brought the remaining 3 to India, of which one, expressly reserved for the Right Hon'ble Lord W. C. Bentinck, was...duly received by His Lordship in

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[1] DDn. 402 (133–49), 1–4–41. [2] ib. (158–9), 11–6–41. [3] First copy of vol. 8 completed in Calcutta, and sent to Dehra June 1843 [113]. [4] DDn. 452 (29–30), 10–6–43. [5] ib. (30–6), 10–7–43.

> October 1830 ; a second was Lieut. Col. George Feilding[1] [III, 177], and I retained one copy for my private use.
>
> The Hon'ble Court presented in 1830...1 copy each to the Royal Astronomical and Royal Asiatic Societies, professing their readiness to comply with requisitions from other scientific bodies, and it was...their intention at the time of my leaving England to sell the remainder at 1 or 1½ guinea per volume. But I have since learned that copies are not obtainable by purchase and, excepting 2 which were received through your office, in both of which the skeleton plan... was wanting, and the reserved copies above specified, ... none...have arrived in India.
>
> Those two public copies are not more than sufficient for the computing office, ... where they are in daily use. My own copy is so constantly applied for on loan that I have been obliged to interdict the use of it to everybody. ...
>
> The book is highly spoken of by Professor Airy[2], one of the ablest mathematicians of the age, in his late treatise on the Figure of the Earth.

He had received requests from people in India, but had asked them to apply

> through anybody rather than me, because the first and only written application (that from Lieut. Western...on the voyage from England) remained yet unanswered. ...
>
> It has all along been my intention to forward to the Hon'ble Court...a list of errata, and an appendix containing many matters which will...prove an useful addition. ... But where is the work in which errata will not be found ? The impression issued from the press only 3 or 4 days before my sailing, ... when I was harrassed by the bustle of departure, the preparations for my voyage, and taking leave of my friends. Whilst correcting...as the proof of sheets came in, I was occupied in measuring on Lord's cricket ground experimentally with the compensation bars, and directing such alterations in the apparatus as were needed [15]. ...
>
> I should conjecture that 100 copies at 16 Rs. or 20 Rs. each would find a ready sale in Calcutta[3].

18 months later 20 copies were received for the official work of the department[4].

The manuscript account of the two northern sections, Sironj to Dehra Dūn, is contained in General Report No. 7 that Everest signed before leaving India in 1843. The published account was written up by him in England during the first three years of his retirement. The Directors pressed for its completion ;

> We feel that the scientific merits of the Indian Arc cannot be fully...appreciated until the report of the whole of its principles and operations is arranged and published. Upon this work Colonel Everest has, at our request, been some time engaged.
>
> It is now suspended in consequence of his absence from Europe [visiting America], but we trust it will shortly be resumed, and...will be published in the course of the present year. We look forward with confidence to the results of its examination by those who are the most distinguished in this country and in Europe in general, for their acquirements in the sciences illustrated in the work[5].

It was duly published quarto size, in two volumes, in 1847 [44], and seven copies reached India in October for presentation to officers who had been employed on the Great Arc, including Lambton's old assistant William Rossenrode.

The first volume contains an introduction of 129 pages, freely quoted here, giving a narrative of the field operations, an account of the professional principles governing the work, and minute descriptions of instruments. It concludes with tabulated records of the observations and of the results deduced. The second volume contains 32 plates illustrating the masonry towers, the compensation bars, great theodolites, astronomical circles, and other special instruments, besides two "plans of triangles"[6].

ASTRONOMICAL OBSERVATORIES ; CALCUTTA TIME SIGNAL

Once the observatory at the Surveyor General's Office at Calcutta had lost the stimulating influence of Hodgson, there was little done beyond observation for Time [III, 186–9, 310], and routine meteorological observations [119].

In 1832 a number of officers co-operated in taking simultaneous observations of Jupiter's satellites for longitude—Daniel Ross, Marine Surveyor General, at his residence in Chowringhee, with his assistant Lloyd—Wilcox, Logan, and Waugh, at the S.G.O. in Park Street—Barrow at the workshop in Loudon Street [125 n.6]—Gray at his observatory in Garstin Buildings—Pemberton "with his own telescope...at Mr. Calder's residence in Esplanade Row". James Prinsep records observations of a transit of Mercury on the 5th May, with help from Waugh and Renny, and from "Mr. Gray, with whose Astronomical clock our chronometer was compared"[1].

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[1] later godfather to Everest's eldest son. [2] Geo. Biddell Airy (1801–92) : FRS. 1836 ; AR. 1835–81.
[3] DDn. 286 (5–8), 20–6–33. [4] DDn. 315 (2–3), 8–1–35. [5] DDn. 461 (24–7), CD to B. (9), 14–1–46.
[6] Reviewed *RAS* (*mn*), VIII, 1848 (116–8), [44 n.2].

In October 1834 a suggestion was made by Alfred Chapman, a ship's captain, that a daily time signal should be made in the harbour, visible to every ship;

> In some suitable place the exact mean time may be shewn, so that all the ships about Calcutta may compare their chronometers...and thereby ascertain the daily rate. ...
>
> I always consider what is termed a watchmaker's rate very dubious, and I conclude that this...has induced the Home authorities to order the exact mean time at noon to be shewn by a signal at the Observatory at Greenwich. There is a preparatory signal hoisted about five minutes before noon, and at the exact noon the signal is made. ... Similar arrangements are made...at Madras and Port Louis [Mauritius][2].

Chapman had no use for a suggestion that it would be sufficient

> to publish a weekly notice in the *Gazette* of the exact times 'of the flash of the evening gun, which...can easily be watched from the river', pointing out that the rating of a ship's watch would require great accuracy. The commander is very seldom on board in harbour, and this must devolve frequently on an inexperienced officer.
>
> I conceive that a person may be found in the Surveyor General's Office who might convey the exact time by a good watch to the flagstaff at Fort William, and at five minutes before noon a ball might be hoisted as a preliminary signal, within six feet of the mast head, and at the exact mean noon it should be hoisted chock up. If this could be done twice in a week it would be a great practical benefit to all persons navigating the Indian Seas.
>
> There is so much misunderstanding as to the longitude of the flagstaff that I...suggest that the longitude in time should accompany the notice, so as to enable us to ascertain the exact Greenwich mean time when it is noon at the flagstaff at Fort William[3].

This was passed to De Penning, who offered every help from the Surveyor General's Office in Chowringhee;

> The plan...of conveying a chronometer to the Fort...may easily be effected. The expence... would be palankeen hire, and a small renumeration to the individual employed...who must... lose nearly 2 hours...from the office duties for that purpose. But...exact mean time could be shown by a signal at the observatory, to be repeated at the flagstaff in the Fort. ... This... promises greater exactness, and would ultimately be attended with less expense. ...
>
> After the preparatory signal is made with the ball, it should be allowed to fall freely at the exact mean noon instead of being hoisted chock up. ... The effort required to overcome the resistance of a body from a state of repose to one of motion would occasion a loss of time[4].

He later reported to the Surveyor General

> that the signal for shewing mean time commenced on the 28th January last [1835], and has been continued every day since (Sundays excepted). The signals are made by hoisting a black ball to the top of the staff on the office 5 minutes before noon, and as a preparatory signal to be followed up immediately at the Semaphore. Then at the exact mean noon, as indicated by the clock and chronometer, the ball is dropped down instantaneously, while the same is done at the Semaphore under the management of a non-commissioned officer.
>
> I have...devoted a great deal of my time...in taking observations for the rate of the clock and chronometer, and making the signals, ... but...have assigned that duty to Mr. Rees, appointing Baboo Nil Comul Ghose to assist [340][5].

The service was interrupted from 16th July owing to the move of the office to new quarters [332], and the signals were not resumed until 10th May 1837,

> from which date the duty has been entrusted to Mr. Rees and two of the Hindoo computers. ... In the original plan...it was proposed to erect the old wooden observatory on the top of a building of about 14 feet high, but...it occurred to me that a pucka building might be erected at the same cost, ... and...Captain Fitzgerald [III, 448], the Civil Architect, ... ordered a pucka building to be erected, ... so that the whole observatory is a good, substantial, pucka building[6].

The signals now proceeded regularly, even though Government refused any special allowance for the staff employed, or for the engagement of an extra assistant on Hindu holidays[1]. In April 1838 De Penning's reference to the extra work thrown on the computing office called down an indignant order from Everest to the effect that nothing whatever should interfere with the computations, and the signals were only allowed to continue on that understanding [108][2].

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[1] *JASB.* I, Sept. 1832 (408–9 ; 504–5). [2] DDn. 294 (97–9), 17–10–34 ; BOC. 20–10–34. [3] DDn. 303 (516), 28–11–34. [4] to Mil Dept. 12–12–34; DDn. 297 (19–20). [5] DDn. 303 (515), 12–3–35. [6] DDn. 352 (46–8), 14–6–37.

The time ball was not always punctual ;

> This day, Monday the 18th November 1839, the ball at the Fort was dropped 3½ seconds later than mean noon. The ball at the Surveyor General's Office was dropped correctly.
>
> This day, Wednesday the 20th November 1839, the ball in the Fort dropped 33½ seconds after mean noon. The ball at the Surveyor General's Office was dropped correctly[3].

From 1855 the signal was changed to 1 p.m. instead of noon, and in 1858 a new time ball was installed at Fort William operated from the Surveyor General's office by electricity. Responsibility was later transferred to the Telegraph Department, till in 1935 it was taken over by the Meteorological Office at Alipore, half the expense, Rs. 290 a year, being met by the municipality[4].

Astronomical Observatories ; Madras & Lucknow

Though he had no administrative relations with the astronomical observatories of Madras and Lucknow, the Surveyor General maintained close professional correspondence with them. He referred to both for corresponding observations, and for data regarding circumpolar stars for azimuth observations [96], and others for zenith distances [97].

After Goldingham's retirement from Madras, the duties of Astronomer were taken over by Duncan Montgomerie until he was relieved by Thomas Taylor in 1830. With the previous consent of the Directors, Everest obtained Taylor's services at Calcutta at the end of 1831 to assist in the measurement of the base-line and comparison of the standard bars.

In December 1831 James Herbert was appointed to Lucknow as Astronomer to the King of Oudh, by whom he was commissioned to organize an observatory and purchase instruments.

> The observatory was founded in the year 1832 by the late King of Oude, Nasar Uddin Hyder, and the first Astronomer, Major Herbert, then Deputy Surveyor General, was chosen by Lord William Bentinck on account of his eminent qualifications, and long and arduous services. ... Major Herbert, having made the preliminary arrangements at Lucknow, and ordered the requisite instrumental equipment from England, died in...1833.

He was succeeded in January 1835 by Richard Wilcox,

> an excellent observer, a skilful mechanic, and practised computer, as well as a tolerable proficient in mathematics. He had, moreover, another rare qualification which...pre-eminently fitted him for the post of Astronomer at a native court. He was a distinguished oriental scholar. This able officer built the observatory, put up the instruments, organised the plan of operations, and brought the observatory into a state of high efficiency. During the course of several years he has collected an immense mass of excellent observations, chiefly planetary and lunar, and therefore difficult to reduce[5].

The "meridian instruments" were ready for use in August 1841, and the observatory was said to have been "the best equipped in India", with instruments of the highest class—a mural circle of 6 feet—an 8-foot transit—and an equatorial of more than 5 inches aperture by Troughton & Simms—with clocks by Molyneux".

The following extracts are taken from Wilcox's letters ;

> 18th January 1844. ... My first assistant...[was] compelled by ill-health to leave Lucknow at the same time that I was called away on regimental duty at the end of last year. The Assistant having been incapacitated, ... I recommended the employment in his place of three educated native youths from the Allahabad School. ... Highly satisfied. ...
>
> 7th January 1846. ... Mr. Airy...pointed out that we ought to take advantage of our more southern latitude to make great number of daylight observations of the planets. ... We have

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[1] DDn. 301 (484–6), 14–11–40. [2] DDn. 348 (140–3), 15–3–38 ; 304 (181), 28–4–38. [3] *Govt. Gaz.* ; DDn. 355 (141). [4] *Statesman*, 17–1–1935. [5] from Waugh, 10–11–48 ; DDn. 462 (232–4).

> certainly made a great number, ... but...we have...a disadvantage belonging to the high range of our temperature. A tremulous motion of the atmosphere...occurs...during the day; ... I have frequently seen *Venus* jump away from the wire to the full extent of her semi-diameter. ...
>
> One could not wish for better observers than our...Hindoo lads, ... and I believe that our transit observations, in which I take no part, ... will compete with those of any observatory. ...
>
> There is no printing press at Lucknow, and Calcutta, the nearest place possessing a press competent to such a task, ... is 600 miles distant. The King, moreover, though willing to pay down at once a sum of 500 £ or 600 £, demurred to a large *annual* expense.
>
> 22nd Jan. 1847. His Majesty has placed £ 600 in my hands for printing the first three years observations, separately, after which he is willing to grant £ 50 or £ 60 annually to have our results printed in the *Memoirs* [RAS], if the Society will accept them[1].

No action had been taken about the printing when Wilcox died in October 1848, and a year later the Principal of Delhi College wrote from Lucknow;

> Two months ago the King abolished the observatory, and the papers and instruments are in charge of a native officer who neither knows English nor astronomy. Some years previous...the King granted six hundred pounds for printing the observations. This sum is in trust of Mr. Wilson of Ghazeepore, the Colonel's executor and brother-in-law.
>
> The observations for three years 1842-3-4 are reduced, and might at once be printed. ... If you think it would be useful to publish them...or...deposit them in mss. in your Society, or in the Observatory at Greenwich, your Society have only to express their views to...the Resident at Lucknow. ... If the papers remain here, they will be destroyed by the white ants in a few years or months[2].

No funds were available and the Surveyor General wrote in 1852;

> The instruments...were constructed by the celebrated artists Troughton & Simms about 1833 to the order of the late Major Herbert. ... The meridional instruments are of the same size and power as those hitherto in use at the Royal Observatory at Greenwich and the Cambridge. .. I consider the Lucknow instruments valuable, and perfectly sufficient for a first class observatory. In fact, they are far superior to the apparatus in the Madras and Bombay observatories. The library, meteorological and magnetic apparatus, as well as the equatorial, would be acceptable to my office.

Waugh had ideas of getting a worthy observatory built in Calcutta, staffed and equipped from Lucknow, provided the instruments could be obtained free of charge, but this came to nothing. In 1855, shortly after the annexation of Oudh, he sent Strange to inspect the instruments and records which were in the charge of

> Baboo Kaly Charan, ... now Treasurer to the Residency, ... formerly assistant at the observatory. ... He appeared to me a person of considerable attainments, and possessed of a complete knowledge of the working of the observatory.

Strange spent a week at Lucknow, and found the instruments in good order, except for want of cleaning and lubrication;

> The transit instrument and the circle...both require cleaning...but they are otherwise in good preservation, as I satisfied myself by putting them in motion. These...are located on the ground floor, each in a lofty and spacious hall with...boarded floors.
>
> The roof is flat. The shutters of the roof are hinged, I believe, but they were partially out of order, and I did not examine them. The wall shutters run in vertical slides, and they descend bodily entirely out of sight into the subterranean appartments below. They were not, however, in working condition, some warping having apparently occurred. ...
>
> I did not see more than a small portion of the records, being unwilling to give Baboo Kaly Churn the trouble of producing them for no definite purpose. He, however, was good enough to show me a few sheets (duplicate copy) of the circle observations. These were neatly and clearly written in ink, and were reduced, but they bore no attesting signatures whatever.
>
> The observations seemed to me, as might be expected, excellent. ...
>
> The...replies by Baboo Kaly Churn to my questions respecting the records...point to a most distressing conclusion, namely that a great part of the labour, skill, and money lavished on the Lucknow Observatory has been expended in vain. ... The first step...is to rescue what remains of the observations from the depredations of insects and place them in safe custody until opportunity offers for having them reduced and published. ...
>
> There seems to be very strong reasons for resuming work at Lucknow itself. If this were done, I believe that the observatory might be in full operation within a period of two or three months from the appointment of an astronomer and assistant. ... There are still at Lucknow

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[1] *JASB.* XVII, 1848 (507-17). [2] to RAS.. 14-9-49 ; *RAS* (*mn*). XI (92-3) ; XII (177-8).

> several men of the establishment formerly employed who are well acquainted with the subordinate duties, ... who would prove very useful on the first resumption of operations.

Kali Charan noted that regular observations both of Mural Circle and Transit commenced in September 1841...and continued uninterrupted till the 6th of August 1849, the day up to which I was there. From September 1841 to the end of 1845 both Transit and Circle observations were reduced, except last of transit observations of 1845. The books of Equatorial observations are nearly eaten up by insects. The greater portion of the materials are eaten up by insects and whatever remain are quite...useless[1].

After the capture and occupation of Lucknow in 1857, James Tennant had the opportunity of visiting the old observatory, and found that the instruments had all been destroyed. He found "that the doors and windows had been removed and the dome of the Equatorial had been perforated by two or three round shot, but that the building itself was unhurt"[2].

"Thus", writes Markham "all the work of this once first-class observatory has been lost to the world, and its records have perished without rendering any result to science"[3].

MAGNETIC OBSERVATORIES

In April 1839 the Royal Society made proposals "for the establishment of magnetic observatories in various parts of...India" in concert with

> a naval expedition...to the Antarctic seas[4], and...the establishment of fixed magnetic observatories in various localities of the British Dominions, to continue during the absence of the expedition. ... Observatories have been ordered to be established amply equipped and officered for three years.
>
> Four stations were to be established in Madras or Ceylon, and at some interior station near the Himalayas, and also at Bombay, ... in correspondence...with the numerous European observatories engaged in similar and simultaneous observation, and placed under the direction of observers who have become practically familiar with the peculiar and delicate manipulations required, by personal communication with...Professor Lloyd of Dublin[5].

The Directors undertook to co-operate, and to "cause an officer of Engineers from each of the three Presidencies, who may be at home on furlo', to make himself practically acquainted with the instruments", and to report to the Surveyor General on return to India. The officers selected were Thomas Jervis from Bombay [II, 307–8, 317], John Boileau of Bengal, and Samuel Ludlow of Madras[6]. Ludlow was directed that, after receiving instructions in Dublin, he should go to Bristol to see the tide gauges which were being constructed there for the Company [119][7]. Later, Charles Elliott of Madras was nominated instead of Jervis to accompany Ludlow to Bristol, and to take charge of an observatory to be constructed at Singapore instead of Bombay [II, 307].

These three officers were placed on special duty from 10th November 1839, and were to return to India by the first ship of the new year, each accompanied by three "sergeants or sappers". Boileau reached Madras in June 1840, and Simla on the 24th of September, some weeks before the arrival of his assistants with the instruments[8]. He had taken observations of dip on his palanquin journey by the way, at Allahabad, Futtehgurh, Bulandshahr, Kernal, Ambala, and Bar at the foot of the hills on the road to Simla[9].

The observatory was established on Bentinck Hill that was later occupied by Viceregal Lodge. The site is clearly shewn on a survey of 1872–4, height 7035 feet, distant about 600 yards west of Peterhoff, then the Governor General's residence. The slopes to the south are marked Boileauganj[10]. Observations were continued from 1841 to 1845, in spite of repeated efforts by the Governor-General to have them discontinued on the grounds of economy.

[1] from Strange, to SG. 12–2–56; DDn. 601 (184). [2] *RAS* (*mn*).. XVIII, 1858 (287). [3] Markham (328). [4] under Capt. James Clark Ross (1800–82); Kt. 1843; *DNB*. [5] from Herschel; 30–4–39; DDn. 343 (230–7); John Fredk. Herschel (1792–1871), 1st Bart. 1838; *DNB*. Dr. Humphrey Lloyd (1800–81); of Trin. Coll.; *DNB*. [6] Samuel Edgar Owen Ludlow, Mad. Engrs. 1830–63, d. 1888. [7] DDn. 343 (286), 13–12–39. [8] these included J. B. Grisenthwaite, W. Craig, and C. Nuttall; *JASB*. X, 1841 (957–66). [9] *RS Progs*. XLII, 1887 (ii). [10] MRIO. Misc. 331–O–74; scales 24 & 8 inches to mile.

The first that Everest knew of all this was a notice in a Calcutta paper of 18th July 1840, an "indelicacy to myself which I am willing to pass over without comment". Whilst expressing the honour he felt at being connected with these plans, and bowing to "a decision thus solemnly passed by...the Royal Society and the Honourable Court of Directors", he asked "to be allowed to disclaim all responsibility as to the success or failure of...the magnetic observations, ... and to consider the gentlemen conducting them entirely independent of my authority".

He suggested that the hills north of Dehra Dūn might be more suitable than Simla, and asked authority to purchase certain scientific books "that I may revive my acquaintance with a subject which I have for a long period been necessitated to lay aside"[1]. Government insisted, however, that Boileau should forward a copy of his observations to the Surveyor General, who should forward it to the Directors with his professional comments. Everest had hoped, he writes to Boileau,

> that the Government would have let me off all connection with this subject of magnetism for, in truth, it is one of which my knowledge is of the smallest possible, ... whether as regards the theory or practice. Besides which, I have but few books treating on the subject, excepting M. Biot's Traité de Physique, and Barlow's Magnetic Attraction, and such like. ...
>
> I am not to escape, ... but am doomed to act like a dead weight upon you and, as...it is obviously of importance to take delight in every occurrence to which we are forcibly subjected, ... even to the pulling on of a pair of tight boots when in a hurry to get in time for the steamer, drinking some wine, and so forth, therefore my best way is to get up the subject as I best may.
>
> You are, I know, an able draftsman—it runs in your family—perhaps you will...oblige me with drawings and descriptions of all your instruments, and, moreover, lend me one or all of the following works—Taylor's Scientific Memoirs—Gauss's Intensitas Vis Terrestris ad Mensurem Absolutam Revocata—Gauss's Resultate—Poisson's Works on Magnetism[2]. ...
>
> Pray convey my kind remembrance to Mrs. Boileau who, I hope, has not forgotten me, and remember that I shall be most happy to aid you in repairing any of your instruments that may get disabled, for which I have not got bad means[3].

Two months later he paid a visit to Simla, leaving Dehra in September 1841 [174], hoping to improve his knowledge of magnetism by "seeing the practical working" of the observatory. He reports in December on "the excellence of all Captain Boileau's arrangements", and recommends that he should take over responsibility for the observatories at Singapore and Madras, and the printing of all their reports in Simla. The Directors then ordered that future reports should be sent direct to England by the several observatories, and that the Surveyor General should be relieved of further responsibility[4].

The observatory was closed down and the staff dispersed towards the end of 1845. The building was dismantled about two years later[5].

The printing press attached to the observatory accompanied Boileau first to Allahābād, and later to Meerut, for printing in 1850

> *A collection of Tables Astronomical, Meteorological, and Magnetical, also for determining the Altitudes of Mountains ; comparison of French and English Weights and Measures, etc* ; computed in the office of the E.I.C.'s Magnetic Observatory, Simla, under the direction of Lieut Colonel J. T. Boileau, Engineers, Superintendent. Umballa. Printed by Richard Craven, at the Hon'ble E.I.C.'s Simla Magnetic Observatory Press[6].
>
> This press...acquired a high reputation for the accuracy and neatness with which...its table-work was executed. After completing the object for which it was established, ... it was transferred to the College for Civil Engineering at Roorkee.

Abstracts of the Simla records were sent to the Royal Society, which published the meteorological observations in London in 1872. The original records and instruments which Boileau had packed for England on his retirement, were destroyed by fire at Agra during the mutiny. The whole of the six years' magnetical observations[7], including those from Singapore were lost.

In 1849 the Directors ordered that Elliott should resume observations at Madras, but he died shortly after starting work on his return from England in 1852. The magnetic survey was then, in 1853, entrusted to the Schlagintweit brothers, and the instruments sent to England from Madras to be tuned up and compared for the purpose.

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[1] to Mil Dept. 28–8–40 ; DDn. 402 (106–10). [2] Siméon Denis Poisson (1781–1840), French mathn. *Ency. Brit.* [3] DDn. 406 (82), 27–5–41. [4] CD to B., Mil., 27–7–42 (4–5) ; DDn. 401 (194), & 405 (103–4), 10–10–42. [5] Mil Dept. to Mil Bd. 5–12–45 ; DDn. 471 (365). [6] GBO Lib. D–b–14. [7] *RS Progs.*, XLII, 1887 (ii–v), ob. notice J. T. Boileau ; reports from GTS. ; DDn. I (83, 160) ; 14–8 & 8–9–1863.

TIDAL OBSERVATIONS

Tidal observations formed no part of the survey programme in Everest's time, and in a letter of February 1834 the Directors wrote ;

> It was not our intention to incur any considerable expense in pursuing this object of science. The Tide Registers should be kept where this can be done without inconvenience, and at a small charge. Wherever scientific men may happen to be stationed within the tide-way, they would no doubt readily undertake the duty, but it cannot be committed...to uneducated Europeans with any prospect of advantage. An incorrect register would be useless, since its inaccuracy would only mislead.
>
> We leave it to your judgement, therefore, to effect the object where it can be done without inconvenience, and at small expense. We transmit for your information a memorandum prepared by our Hydrographer, Captain Horsburgh, on the subject[1].

Doubtless in pursuit of this policy during the course of his revenue survey, Henry Siddons in 1835 had a series of tidal observations taken on the coast near Chittagong by his assistant C. W. Mullins[2].

In 1839 Elliott and Ludlow, of the Madras Engineers, were deputed to visit Bristol to see the self-registering tide-gauges which were being made there by a Mr. Bunt [117][3]. The gauges were being made on the order of the East India Company in order "that a series of tide observations shall be carried on in various parts of India", and one of them was to be set up at Singapore under Elliott's supervision[4]. A daily register of tides had been kept up at Singapore from September 1834 to August 1835 by Mr. J. Dias, "an extra person" engaged by the Master Attendant at the request of Professor Whewell, who published in the *Philosophical Transactions of the Royal Society* "14 laborious memoirs on Tides, 1833 50"[5]. Dias drew no salary for these observations, but was allowed a gratuity of Rs. 100[6].

METEOROLOGY

Regular meteorological observations were kept up at the Surveyor General's offices at Calcutta, Dehra Dūn, and Mussoorie[7] [III, 273]. Copies of the Calcutta registers, besides being published in the *Journal of the Asiatic Society*, were regularly sent to Everest's parson brother at Delhi [33, 120], who kept up his own observations and contributed a number of papers on the subject[8].

Interesting records were sent to the Surveyor General by Dr. Rhodes at Cherrapunji, widely known as the station with the heaviest rainfall in India, being perched at the head of the south-east escarpment of the Khāsi Hills [III, 64, 273]. He writes in April 1831, before the monsoon ;

> The barometer and thermometer are...in a room opening by a glass door to the westward, by which the apartment is lighted. It is very small and...has to serve me for bedroom, baggage, and everything else but dining ; consequently it is much warmer in the morning than it ought to be. During the day, however, half of the folding door is allowed to remain open, and the temperature of the room is about the same as out of doors in the shade. The barometer stands behind the open half of the door, and is thus pretty freely exposed, but requires some care to shade it from the evening sun.

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[1] CD to B. (Pub), 24-2-34 & 1-5-35, with memo. on Mar. Dept. obsns. at Kidderpore Docks. [2] *JASB.*, VI (949) ; Markham (212-3). [3] T. G. Bunt of Small Street Court, Bristol. [4] *JASB.* XIII (ii), 1844 (xxvii), Tidal Registers, Singapore, June-Oct. 1842. [5] Rev. Wm. Whewell (1794-1866) Master of Trin. Coll. Camb. from 1841 ; FRS. ; FGS. ; *DNB.* ; *Phil Trans.* 1835 (15-84). [6] *As J.* xix, 1835 (201-13). [7] GBO. Comp. M-9/4 ; Weather Reports, Park Ho., J. O. Nicolson. 25-6-39. [8] *JASB.* VI, 1837 (108) ; VII, 1838 (192-6) ; VIII, 1839 (313-6).

> The temperature of the air is then, I believe, correct. For the evaporating surface, the thermometer, having the bulb covered with a piece of muslin thoroughly wetted (after the manner shown me by Captain Herbert), is hung close to the dry one, and seldom is more than 2½ or 3 degrees below it, often...nearly the same [III, 240].
>
> I have...been acting incorrectly in keeping the thermometers indoors, but we had no place here to put them where they would be safe but the room before mentioned. ...
>
> The climate...has, during the months that we have been here, felt anything but damp, except when the occasional clouds are passing and envelope the hills and, as to the salubrity of the climate, the present healthy state of the detachment speaks highly in its favour[1].

Again, in June, shortly before the commencement of the monsoon ;

> The remark in the Hurkarah[2] that *the rains had set in with great violence at Cherra* is incorrect. By a reference to the Table, it will be observed that for the last 20 days of the month [May] the weather has been remarkably fine, and almost free from rain. By a self-registering thermometer set at the beginning of the month...the temperature during the day has been as high as 76°, and at night as low as 56°. The climate now is very delightful, and surpasses the finest summer months in England[3].

Everest encouraged his surveyors to keep up meteorological records, and writes to Murphy at Agra in 1833 about a raingauge ;

> Data, unless they are accurate, are worse than no data at all, and do more mischief than benefit by propagating error. As you are an ingenious person, I wish you would try to manufacture a raingauge on the principle of that which was offered to me for sale last year. ... Whether the thing will answer I do not know, but the principle is clever, and if the pivots of the wheel-work be highly polished in the first instance, and all kept clean, and slightly touched with goose oil, I see no reason why it should fail.
>
> Little pieces of agate for the pivots...would help to preserve the motion. ... Where so much moisture is concerned steel pivots would not do, so that you must get the hardest brass. ... The advantage of the arrangement is that it renders you independent of evaporation[4].

In 1839 Bedford reported that the "upper rain gauge at the Surveyor General's Office is quite useless for heavy falls of rain, as it shows but two inches", and he indented for one with cylinder 4 feet long and 3 inches diameter, with a cup of 6 inches diameter, to be made of copper.

In 1832 an Indian Committee of the "British Association for the promotion of Science" was formed of gentlemen in India, having "the science of Meteorology as one particularly fitted for...early attention". The first members were Sir Edward Ryan, a High Court Judge—George Swinton, Secretary to Government—Richard Benson, Military Secretary—James Herbert, Astronomer at Lucknow—Dr. Turnbull Christie, of Madras Medical Service and James Prinsep, Assay Master. The last-named, being Secretary, asked that the Surveyor General might supply all the instruments he could spare, and reported that "the Madras Government has been induced to write to England for twenty complete sets of the best meteorological instruments"[5].

GEOLOGY

There had been no official geologist with the Great Trigonometrical Survey since the time of Voysey [III, 264–6, 508–10], though James Franklin had applied for the post without success [III, 499]. Everest encouraged all his surveyors to make collections in an amateurish way, as indeed, the Directors had particularly asked.

> It is an invariable rule with all my subordinates to collect specimens at my different stations, and give descriptions of the formations of the countries we pass through, a duty in which Lieut. A. S. Waugh...stands pre-eminent amongst us [271][6].

Reports and specimens were generally passed to Everest's brother, who was a keen geologist, and contributed a number of papers to the Asiatic Society[7].

In one place[8] Everest refers to the geological work of Turnbull Christie, who had worked in the South Marātha country, and written many papers for the *Edinburgh*

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[1] DDn. 264 (192–4), 2–4–31. [2] *Bengal Harkaru.* [3] Cherrapunji, 4,455 ft. above sea [III, 273 n.7]; DDn. 284 (113), 3–6–32. [4] DDn. 321 (34–5), 12–9–33. [5] BGC. 18–12–32 ; DDn. 282 (214–8), 21–12–32. [6] Everest (45). [7] *JASB.* I, 1832 (157, 238–42, 549) ; II, 1833 (475–81). [8] Everest (44).

New Philosophical Journal[1]. No official encouragement was, however, given to John Campbell, one of the Madras surveyors, who was an enthusiast on many subjects besides his professional survey [252, 259] and writes from Salem ;

> With regard to the Geological Survey, ... it is impossible to say...of what advantage it may prove to be in a mineralogical and commercial way. But lately only I have discovered inexhaustible stores of Carbonate of Soda, which...can be easily purified by crystallization, and which a commercial gentleman is now trying to introduce into the market in England. A supply...would be invaluable, just...when the supply of sulphur required for its production in England has been cut off, while...pure salt can be here produced for a mere nothing. ...
>
> I do not profess to be what is called a Geologist, never having studied in England, and, ...like Dr. Boaze[2], am inclined to disbelieve the correctness of the theories of the whole science. ... I possess a tolerable knowledge of mineralogy to enable me to describe rocks correctly, and also a tolerable knowledge of chemistry to examine some unknown ones. ...
>
> My plan is to complete an accurate...description of the Geology and Mineralogy of this district and a geological map, ... 4 miles to an inch, in which I have...made considerable progress, and have published a short account of results in the 26th No. of our journal. ... I then further propose extending the examination and the map to the whole of the...peninsula south of Madras, using the atlas sheets to colour. ... Any practical geologist will see...that with a good telescope, and riding over it once or twice, a very tolerable idea of the geology may be ...rapidly obtained. Furthermore, we have no scientific account of South India at all, and my map of Salem and the Barramahal [I : 113–4 ; pl. 9 ; II, pl. 16] will be the first geological map, I believe, ever published in India [III, 200, 268, 449, 457, 510][3].

Campbell continued these researches without official authority until he was reverted to regimental employ in 1844.

Several surveys of geological interest mostly dealing with coal were made by the Bengal surveyors. In 1832–3 Waugh and Renny kept useful notes on their survey through Rohtāsgarh to Jubbulpore[4] [24, 271], part of the same area being covered by Wroughton's revenue survey of 1841–2[5] [228]. Walter Sherwill also, in the course of his revenue surveys between 1842 and 1851 [184], made a

> Geological Map of the northern front of the Vindhya Hills, extending from Allahabad and Rajmahal, shewing all the known coal beds of that tract ; also of the silver, copper, lead, and antimony localities, as well as the principle iron measures. With vertical sections.
>
> It covers the whole country between parallel 22° and the Ganges, and stretches as far as Calcutta[6].

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[1] *Edin. NPh J.*, V, 1828 (292–304), etc., *JASB.* X, 1841 (933). [2] Henry Samuel Boase (1799–1883), geologist ; MD. Edin. 1821 ; *DNB.* [3] DDn. 387 (211), 18-7-49. [4] Geological section, Chunargarh to Jubbulpore, MRIO. 76 (17–18). [5] ib. 57 (22) ; 76 (57). [6] ib. 17 (42A).

CHAPTER VIII

REPAIR OF INSTRUMENTS

Mathematical Instrument Maker — Calcutta Workshop — Field Workshop — Astronomical Circles.

EVEREST had long recognized the need of a skilled mechanic, to keep his instruments at high working pitch, and whilst in England had asked the Directors to send such a man out to India, so that valuable instruments

> may be repaired without the loss, risk, and attendant expences of being sent home. Instruments...not...of sufficient value to warrant being sent home whenever they happen to be injured are now thrown aside as lumber [III, 258-60 ; IV, 143][1].
>
> I had for years been convinced of the necessity...of having a good practical artist of this class at one of the three Indian presidencies. ... Mr. Barrow was introduced to my acquaintance in January 1829 by Mr. William Richardson of the Royal Observatory, who was at that time assisting me in computations connected with the Great Meridional Arc [III, 406-7].
>
> I found him an intelligent, clever, person, one of the *principal workers of the trade.* His character stood exceedingly high with the most eminent opticians in London for ability, punctuality, and unimpeachable integrity, and from the profits of his employment by Troughton, Dollond, Jones, Watkins, and others, he cleared between 300 and 400 £ per year. ... I had no scruple whatever in mentioning Mr. Barrow, and my proposal was readily acceded to by the Court of Directors on his producing testimonials highly creditable to himself[2].

Barrow was appointed on "sa. Rs. 500 and...house rent for himself and workshop, sa. Rs. 200", and accompanied Everest to Calcutta where accommodation was found for him and his family over the workshop [125]. He was soon fully employed collecting and training his staff, fitting up the machines, and helping with the new base-line apparatus [45-6]. When, however, Everest found time to look into the workshop, he discovered that Barrow did not like interference. He was over 40 years of age, and of sturdy British character, and it was not long before the Surveyor General took exception to a freedom of speech that was new to him :

> The style in which you presumed yesterday to accost me was such as to be totally incompatible with our relative situations. ... For many days past I have perceived an inclination on your part to be offensive. ... After imputing to me an assertion which I never made, you rudely and flatly contradicted me twice. ... The tone and manner which you assumed were insulting and overbearing in the extreme, and totally at variance with that respect...which I will insist on preserving inviolate. ...
>
> It has been my study...to make your condition as comfortable...as I could. ... I have exercised no vexatious or unnecessary controul over you, but have left you the free use of your own judgement to an extent quite unusual in this service. ... If you compel me to have recourse to...higher authority, you will have yourself only to blame[3].

Everest thereupon laid down meticulous rules for the conduct of the workshop and its staff, and for the submission of regular daily reports and—to establish his authority beyond further dispute—sent a copy of these to Government, together with a detailed account of the unseemly wrangle that had taken place. Government supported his authority; but doubted the wisdom of some of the rules which seemed "calculated to impair rather than to promote the efficiency of the establishment"[4].

Though Barrow gave Everest an assurance in writing that he would "always be most ready and happy to attend to your orders", there was constant friction between them, and though Everest had given permission that extra-departmental work might be undertaken so long as it did not interfere with work for the survey [127–9][1], he reports later that Barrow had "in diverse instances acted in direct violation of the rules which I laid down".

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[1] Com Corr. 13-12-29 ; CD to B., Mil., 10-2-30 (1-2) ; DDn. 90 (83) ; 453 (127). [2] SG. to Mil Dept. 4-11-30 ; DDn. 265 (70-4). [3] DDn. 266 (147-9), 22-2-32. [4] BMC. 12-3-32 ; DDn. 282 (40-1).

> The daily report for the month of June...will show that only 2 men have been regularly employed in the work of my department, and 2 others for 5 days each, whilst the time of the rest has been taken up in shot-gauges and other matters connected with the Arsenal. ...
>
> I left...the 18-inch Altitude and Azimuth Instrument...all but complete [143], and though...it was urgently wanted for field operations, yet it too has been put aside for the arsenal business, and...cannot be sent with the rest of the instruments...to the Upper Provinces[2].
>
> In the construction of the large theodolite...Mr. Barrow has taken upon himself to overrule...my arrangement. ... The first artists in Europe...never took so much upon themselves. Mr. Troughton, if he had any objection to offer to my propositions, offered them in the first instance but, having once agreed on the feasibility of any plan, he never took upon himself to deviate from it.
>
> Mr. Barrow is a person of...no celebrity, and —further than his being an able mechanic— his opinion...is of no weight whatever. ... Astronomers and geodesists are the best judges of the instruments which they are to use. I...hope that some method will be devised of ensuring Mr. Barrow's due obedience to my authority for, if that cannot be done, ... the object which actuated me...to incur so large an additional expense will be entirely counteracted.
>
> I did not include Mr. Barrow's name in the party to accompany me into the field because his removal...would have interfered with the construction of the very two instruments...which I concluded would by this time have been finished. Neither of my anticipations has, however, been realized. ... The remedy...is to place Mr. Barrow, like all other individuals of my Department at the Presidency, directly under...my Chief Computer, Mr. De Penning[3] [108, 341].

Government did not agree that Barrow should be placed under De Penning, but made him understand that he must obey orders.

In 1837, when Everest found it imperative to have drastic alteration made to the new astronomical circles, Government permitted Barrow to join him up-country [98], and hand the workshop over to De Penning[5]. As the move was to be "of a very temporary nature", involving "increased establishments and additional expence", he was allowed an increase of one third of his permanent salary [127][5]. Leaving Calcutta on 11th August, he reached Dehra on 13th September, and writes cheerfully from Kaliāna during October;

> It is certainly annoying that we cannot get either workmen or tools, but I do not fear of being able to complete the alterations to the circles with the present means. ...
>
> Many thanks for the obliging offer of your house, ... but we do not stand in need of it, as we have hastily raised a place with mud walls, 20 feet long, 7 wide, which will answer every purpose for casting and forging. We have already cast in it one of the ends for the base of the pillars, and the four platforms for the outriggers, besides smaller pieces. ...
>
> In the daytime the weather here still continues intolerably hot, 88°; ... early in the morning it is only 50°, which is pleasant enough[6].

The work to be done was by no means simple or straightforward, and Barrow had several mishaps, due, no doubt, to the makeshift local arrangements. After a few months considerable ill-feeling was engendered, which culminated in his refusal to "divide" the new circles as Everest desired;

> When Mr. Barrow was with me at Kaliana in October of last year, shortly after his arrival from Calcutta, I explained to him a plan...of dividing circles very expeditiously by copying the divisions of one previously divided [133–4], and he then not only distinctly gave me to understand that he thought my plan very likely to be successful, but assured me that he would do his utmost to render it so.
>
> In this frame of mind he seems to have remained until the 29th August. ... On that date he asked me to let him have 6 months leave, and on my replying to him 'get the work done first'...he got so angry that I was obliged to call him to order. ...
>
> About three days after this, he again accosted me in the workshop in a tone of increased anger. ... I believe he said...something to impugn my plan of dividing, ... but his passion seemed...to have so far gotten the better of his reason, that I neither clearly understood what he meant to say, nor do I believe he understood himself. ..

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[1] to Mil. Dept. 15–11–32; BMC. 19–11–32 [100]. [2] Cary, 18", MO. [142–3]. [3] DDn. 286 (43–9), Mussoorie 3–8–33. [5] DDn. 296 (19), 17–7–37. [5] DDn. 341 (139–40), 24–3–37. [6] to SG., DDn. 302 (121), 30–10–37.

> Finding that no steps were being taken...to proceed with the division of the circles, ... I addressed him a letter on the 5th November, in which I entered into a detailed description of the method, ... in answer to which I received a letter...alleging inability to divide the circles at all, and declining all further discussion. ...
>
> If Mr. Barrow cannot, or will not, divide instruments, he is not required in India. There is nothing whatever, save this, in which my sub-assistant, Said Mohsin, is not his equal, and... [in] many points...his superior, being in far better practice as a workman[1].

To Barrow himself Everest recalled that,

> when you first offered yourself to proceed to India, ... you clearly gave me to understand that you were able to divide instruments by the hand. ... Since your arrival in India you have succeeded in dividing the 3-foot circle of the old large theodolite in a manner altogether masterly, ...to my entire satisfaction [134, 142]. ... When you state your inability to divide the new circles, ...you must mean to say that you are unable to do so by the method which I suggested...
>
> I am not wedded to any particular method ; dividing instruments is not my business. ... The division of both the new circles must...be effected before you quit the Upper Provinces. ... Your are at liberty to proceed with the division in your own way. ... You will lose no time[2].

As nothing would induce Barrow to adopt a more reasonable attitude, he was sent back to Calcutta and discharged on the 19th April, 1839 [98, 134].

During his absence up-country, charge of the workshop at Calcutta had been nominally vested in De Penning, until in November 1838 it was entrusted to Ernest Gray [III, 218 ; IV, 128]. When, therefore, on Barrow's discharge Everest pressed for the permanent appointment of that excellent workman Saiyad Mir Mohsin Husain [III, 485], Government pointed out that "Mr. Gray is already in charge of Mr. Barrow's establishment receiving...a salary of 350 rupees per mensem, and...as Mr. Barrow was appointed by the Court of Directors, the nomination of his successor ...rests with the Hon'ble Court".

Everest thought it unfair to allow the temporary appointment of Mr. Gray to stand in the way of Mohsin Husain's promotion ;

> Mr. Barrow was appointed...for the express purpose of...keeping in order the instruments of the Great Trigonometrical Survey of India. ... Since 1st July 1835 no work...for the G.T. Survey has been executed by Mr. Barrow's establishment in Calcutta. Manifold...duties for which Mr. Barrow was expressly nominated have all been executed by Seid Mohsin under my guidance and, ... though Mr. Barrow received the salary, Said Mohsin did the duty. ...
>
> Mr. Gray...holds temporary charge...at the Presidency for 6 months...from the 12th November[3], but that establishment might be abolished tomorrow without detriment, for...I shall never require any work whatever to be executed for the G.T. Survey by Mr. Gray whilst I have Seid Mohsin. ... The temporary occupancy...by Mr. Gray...may...promote the repair of the instruments of the Revenue Surveyors, but that...is quite another question[4] [128-9].

Government still hedged and, whilst suggesting that Mohsin Husain might in time succeed to Barrow's post, and "as there is now no very delicate or difficult work to be executed for the Trigonometrical Survey", appointed Alexander Boileau to take over charge of the Calcutta workshop, in addition to his other duties, which he did from 1st December 1839, holding charge till 1843 [129].

In the meantime the skilled services of Mohsin Husain were in constant demand in the field. For the zenith distances special arrangements were made for him to travel by *dāk* to help Waugh at Kaliānpur, and then return to Everest at Kaliāna ;

> Astronomical instruments...are even more delicate and more likely to get out of order... than mural circles, besides which in travelling over a journey of 400 miles and upwards, over wide and stony roads, they are exposed to more and greater accidents.
>
> Now, if a screw were to get loose, ... or any like accident arise in one of the mural circles at Greenwich, that instrument would only be powerless until the coach from Charing Cross had brought up Mr. Simms, or Mr. Jones, or Mr. Dollond, ... armed with all the skill and appliances of London workmanship. ...
>
> But in our case, if a screw were to get loose, not only would the instrument...lie idle till repaired, but...the other instrument operating at 400 miles from it would likewise be rendered null by the want of simultaneity. ... The only safeguard...is to send...Seid Mohsin to Kalianpur and back by dak, for which...authority may be granted...to incur the expence[5] [99].

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[1] to Mil. Dept. 9-11-38 ; DDn. 342 (252-3). [2] DDn. 348 (357-61), 7-11-38. [3] extended a further six months. [4] DDn. 344 (72-4), 21-5-39. [5] Report 3-8-39 (192-5).

Everest reiterated the Mir Sahib's invaluable work [130–1] on

> heliotropes, lamps, barometer pumps, theodolites, ... everything in short which constitutes the duty of a mathematical instrument maker to repair, exceeding by far which Mr. Barrow did in the same period, though the salary of Rs. 600 per month was paid to the latter, whilst the unfriended Seid received nothing for his toil but the satisfaction of my poor applause. ...
>
> The two astronomical circles – ... if it had not been for Said Mohsin, there would have been no prospect whatever of bringing that delicate...job to a termination. ... If Mr. Barrow had ever dreamed that it would be practicable for the Seid to make...and use the cutting tool with expertness, he would have thought twice before he broke out into open disobedience. ...
>
> In 1832...I did...work with my own hands at the lathe and file, but as a workman I was even then inferior to Seid Mohsin, and now am no more fit to compare with him in that line than I am in Divinity with my Lord Bishop of Calcutta, or in law with my Lord Chief Justice.
>
> I found him in Calcutta in 1830, little prized by anybody, deeply regretting his former kind patron [Blacker], and...half disposed to return to his native country, ... and...I was not long in perceiving the distinguished qualities which marked the Seid. ... The...irritable tendency of Mr. Barrow...rendered it prudent...to make myself as independent as I could of his services, and so early as 1832, when this cross-grained person was under...his first periodical fit of perverseness, I was enabled to construct the most delicate parts of the complicated apparatus for comparing bars or chains without his aid, ... through that of Seid Mohsin. ...
>
> He has been present at the measurement of 3 bases. ... Whenever any portion of the complicated base-line apparatus was deranged he put it to rights. When the large theodolite by Troughton was found at first trial unfit for work, he rectified its defects [141]. When the reverberatory lamps...were still useless...he rendered them eminently efficient [88–9]. When the cranes...were unavailable for...raising the large theodolites to the summits of the observing towers [83], he constructed others. ... I have not to record one instance of reluctance to undertake, or failure in effecting, what I have entrusted to his management. ...
>
> As to the salary, ... where will a person be procured the equal of the Seid for the sum of 350 rupees per month ? Mr. Barrow is a fair specimen of what might perhaps be obtained, ... but he cost—...all in all, house, workshop, travelling expences, etc.—not much less...than 1,000 rupees a month, and was insolent into the bargain, and seemed to think he conferred a favour on the East India Company by serving them at all. ...
>
> Though Mr. Barrow was a skillful workman, yet, latterly at least, he was really not so expert as Seid Mohsin and—as to the practical part of conveying instruments on the march, and the various wants of parties in the field, ... or doing anything out of the mere routine of his own particular business—Mr. Barrow was about as completely helpless as need be[1].

Reference was made to the Directors, who accepted "Seid Mohsin as a fit successor to Mr. Barrow as Mathematical Instrument Maker", but left his salary to be fixed by the Government in India[2]. In spite of Everest's recommendation that he should be given Rs. 350 p.m., with charge of a depot of instruments and a staff of artificers up-country, Government ordered that he should be stationed at Calcutta with a salary of only Rs. 250 p.m., and designated 'Head Artificer in the Department of Scientific Instruments'[3]. Everest protested so strongly that the Directors then ordered that he should be termed "Mathematical Instrument Maker, and...to the greatest possible extent...[made] available to the trigonometrical surveys...as recommended by the Surveyor General"[4] [131].

CALCUTTA WORKSHOP

No. 7/6 Theatre Street was leased at Rs. 175 p.m. for a period of three years from 1st December 1830 "for the personal accommodation and workshop of Mr. Barrow, Mathematical Instrument Maker" [122][5]. This was not in the present Theatre Road, but somewhere near Lyons Range, north of Esplanade East[6]. It was still occupied by the workshop in 1838.

> This house...is the property of Baboo Seeb Persaud Ghose. ... If rented for a short period the owner requires 200 rupees per month, but if taken on a lease of 3 years it can be had for 175 Rs. per month, taxes included. ... A ground plan is annexed. The ground floor is dry,

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[1] DDn. 402 (82–95 ; 133–49) ; 24–7–40 ; 1–4–41. [2] CD to B., Mil., 1–9–41 (9). [3] DDn. 401 (116–21), 26–1–42. [4] CD to B. 26–9–43 (35). [5] from Mil. Dept. 6–11–30 ; DDn. 263 (201). [6] bu *JASB.* ; I (504–5) shows Barrow at Loudon St., Chowringhee, in 1832 [114].

> and consists of a...middle room 38 feet by 22, lying nearly north and south longitudinally. On the east side are two rooms 18 feet by 16, and a similar number on the west side. On the north side is a room 18 feet by 7, thoroughly protected from the rays of the sun, ... which...adapts it well for the purpose of a dividing room. There will, therefore, in the lower floor be quite sufficient room...for...workshops and store rooms. ...
>
> The first floor is laid out similarly to the lower floor, and will...allow for the private accomodation of the artist and his numerous family. ... I...can find no house so well calculated to the purpose on so low a rent[1].

"Quarters No. 8 in the Rampart Barracks in the Fort" would not be suitable, wrote Everest, as there would not be room for Barrow's family and because,

> after closely examining...the different rooms, and their situation with regards to light and aspect, it is my conviction that they never can be converted to the purposes of a workshop. ... He would...find it necessary to place together in a room a lathe, a vice-bench, and an apparatus for dividing. But...it is essentially necessary that the dividing room should be kept quite separate...under lock and key, and never entered but by the artist himself, or some one in whose discretion he particularly confides.

Barrow was allowed a writer, 4 armourers, a turner, a carpenter, besides peon, *durwān*, and sweeper, and "authorized to submit...a monthly contingent bill, ... and to indent on the Arsenal for such castings in brass, as well as tools or materials as ...can be supplied from that source"[2]. In May 1831 his staff was increased "as a temporary measure" by 4 vicemen @ Rs. 7 each, 1 turner @ Rs. 8, and 1 carpenter's mate @ Rs. 9. Work had been started on the circular instrument by Harris [143]—Lambton's Great Theodolite [142]—Cary's repeating circle—the boning instrument—and the comparison of the steel chains against the parliamentary standard [47][3].

It was not easy to find workmen of the right type and, when a consignment of instruments came up from Madras for repair, Barrow preferred to put it aside rather than engage unskilled men [127][4]. Everest issued precise instructions regarding the management of the staff [122];

> The artificers...are public servants. No new artificer is to be engaged, neither is any one to be discharged...without the knowledge and approval of the Surveyor General.
>
> No artificer...is to be employed...[on] private instruments, unless...[these are] to be used in the public service, for which the express sanction of the Surveyor General is necessary.
>
> A present state will be furnished every noon to the office, ... accompanied by a statement of work executed since the preceding noon. The establishment will be mustered on the 1st of every month at the Surveyor General's office at 8 o'clock in the morning. ...
>
> An acquittance roll will be drawn up every month and duly signed by each individual.
>
> Men who absent themselves, except on the ground of real and certain sickness, or on leave expressly granted, are to have their pay stopped, ... and the...deduction...carried to the account of Government. Leave of absence is to be given in the first instance by the Mathematical Instrument Maker, but will not be valid unless sanctioned by the Surveyor General[5].

On Barrow's protest, a monthly change statement was substituted for the muster parade and acquittance roll.

He particularly resented Everest's constant interest in the progress of work and refused the services of Mohsin Husain ;

> I hope the instruments I have undertaken to repair and alter may be left entirely to my own execution and performance. ... When you lately personally proffered me the assistance of your separate establishment, I then declined, as I now again do, accepting such aid as interfering too much with my own business.
>
> You must, I am sure, see the propriety of my not accepting your mechanical assistance, but yet I shall always be happy...to afford you mine in instruments you may undertake to repair at your separate establishment, but...it forms no part of my duty to teach others[6].

He complained of 'absenteeism' : "The workmen...from the Arsenal are exceedingly irregular ; ... Bipod has attended only four days, and Cossey five days, for the past month"[7]. The better men began to drift away, as they profited by Barrow's instruction, and the Surveyor General pointed out that

[1] DDn. 265 (70-4), 4-11-30. [2] DDn. 263 (216-8), 31-12-30. [3] DDn. 302 (17) & 263 (280-1), 27-5-31. [4] ib. (22), 31-1-32. [5] DDn. 266 (147-9), 22-2-32. [6] DDn. 302 (38), 23-6-32. [7] DDn. 309 (49), 1-12-32.

> such men will be eagerly sought for by those who work on their own account—Mr. Augier, Mr. Jessop, Mr. Gray, etc.—and thus the rough material having been worked up at the expence of Government, others will reap the profit. On this account I...recommend the undermentioned...for an increase of wages, with the prospect of further augmentation. ...
>
> Radanath .. .. present rate, Rs. 12 ; proposed rate Rs. 15.
> Narain .. .. ,, ,, Rs. 8 ; ,, ,, Rs. 11.
>
> It is found to be a great evil...that the native workmen have so many holidays during the year. ... It is notorious that such workmen as are skilful do not waste those days in holiday-making, but employ them in executing private work.

As a remedy he suggested overtime pay for official work during holidays[1]. The establishment on 1st January 1837 included 1 writer @ Rs. 25, 14 workmen, and 3 "menials", total Rs. 143–10–4 a month[2].

Whilst complaining to Government that work on his more important instruments was being neglected [123], Everest wrote imperatively to De Penning ;

> Mr. Barrow having disobeyed the instructions which I gave him, ... you will make it your particular business to see that he abides by them for the future. ... The artificers...shall not be taken off their proper work to be employed in that of other departments. ...
>
> If, without delay to the...instruments of my department, ... the artificers can be spared to execute other public business, you will...allow of that, ... reporting the same specifically to me. ... Otherwise, unless under an express order from...the Council, ... you will admit of no deviation from this...rule. When the work of my department is out of hand, it is my intention... to dispense with the surplus artificers, or at least not to allow their pay to be charged to my department, which is already unavoidably costly [17, 129].
>
> The Madras Observatory instrument was all but complete before I left the Presidency, and...the utmost time required...would have been one month. ... In 1831, Captain Montgomerie obtained my permission to send round...a considerable portion of injured instruments belonging to my department under the Madras Presidency. ... Nothing has yet been done[3].

The repairs of the 5-foot transit for the Madras Observatory were completed by March 1835 at a cost of Rs. 203–5–0, including return freight to Madras.

Though De Penning's official charge was the Computing Office, yet Everest sent him most of his orders regarding the workshop, in preference to writing direct to Barrow. De Penning was, moreover, responsible for despatches and receipts, and Everest writes to him from Dehra regarding

> the trestle which Lieut. Shortrood [*sic*] sent from Bombay [56]. Get...a correct model of it sent to me (1 inch to 1 foot), and let the original be carefully returned ; ... I enclose an order to Mr. Barrow. ... If he should still be disobedient, a further statement...must be communicated to me forthwith, that I may lay the matter before Government, as I have done his former acts of refractoriness Be he refractory, however, or be he obedient, the model must be constructed somehow or other, and I know one person who will do his utmost to meet my wishes ; that is Mr. J. De Penning[4].

When Barrow went up-country in 1837 [98, 123], he took with him neither workmen nor tools and, when asked to send these up from Calcutta, De Penning sounded

> the workmen to ascertain...if any of them were willing to proceed. ... I put the question direct to...Holdar Mistry, Khosaul, and 2nd Modoo, proposing them in the first instance one third addition of their present salary, explaining them at the same time all the advantages they would derive by going on the steamer, but without any success.
>
> I proposed half their present salary but, finding them very loath to proceed I told them... that, as their services were urgently...required, two of them must decide, and state their own terms. ... Holdar Mistry engaged to proceed on...35 rupees pay per month and 5 rupees batta, ... with assurances of good treatment, and no stoppage when sick. Khosaul and 2nd Modoo declined altogether, saying that they could not quit their parents.
>
> I then made the proposal to the other workmen, and the following have agreed to accompany Holdar Mistry if allowed 24 rupees per month, including batta, viz.—3rd Modoo—2nd Thakur Dass—Mehdut—Beekhum. Mr. Barrow, being well acquainted with all the workmen, could make his choice of the above four.
>
> There being no steamer available, and the Doorgah Poojah holidays intervening[5], I...refer to you. ... The Governor General having engaged all the steamers for his party proceeding to the Upper Provinces, no steamer will be available...till the latter end of November[6].

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[1] DDn. 283 (120–1), 8–12–32. [2] MIO. Páybills. [3] DDn. 282 (332–5), 3–8–33. [4] DDn. 316 (87–9), 19–10–33. [5] Hindu holidays, extending about 2 weeks, Sept. & Oct. [6] DDn. 304 (71), 2–10–37.

Everest would not hear of the terms demanded, though in urgent need of assistance on the heavy alterations to the astronomical circles, for which his small staff of up-country artificers was insufficient [129–30].

> With the whole body of my artificers combined, I would not calculate on completing these alterations in less than 3 years. ... In consequence of the base-line measurements which I have in hand, I am obliged to take one half, including 4 of the most skilful, with me to Seronj, thus leaving with Mr. Barrow only one half of the whole number.
>
> I am deeply...mortified at the result of Mr. De Penning's discussions with the workmen, who...have shewn themselves most unworthy servants. ... Pretensions so extravagant...cannot be listened to for an instant. ... I...suggest...that they be instantly dismissed, ... and the whole establishment at the Presidency broken up pending Mr. Barrow's return.

He asked that the up-country ordnance magazines should each send to Kaliāna two of their "ablest workmen in brass and iron" as well as "lathes and tools of all kinds", and that he might engage "clever artificers temporarily, ... the rates of hire to be as reasonable as I can make them" [130]. Government agreed, and De Penning reported on 7th December that "the whole of the artificers of Mr. Barrow's establishment have been forthwith discharged". To meet orders for revenue surveys and the ordnance department new and inferior men had to be entertained[1].

To his complaint that he knew nothing about instruments, De Penning got little sympathy from Everest;

> When a servant is call upon to execute any duty for which he is expressly paid, and which he has never professed himself able to fulfil, it is incumbent on him to state his inability, though his good will is unabated. For example, if I were called upon to make shoes, boots, or breeches, I should state in most respectful terms my willingness to try my hand on the job, but at the same time most deferentially point out the inevitable punishment that would await the unfortunate persons who might be doomed to wear those articles.
>
> I think [that] if in like manner it were brought...to the notice of the Hon'ble Mr. Amos[2] that you knew about as much of adjusting telescopes as the man in the moon, he would be rather reluctant to trust an instrument of any value in your hands. ... If, after such a candid avowal, the Govt. were still to insist on your acting the part of an optician, ... you have nothing [to do but to comply][3].

To allow of closer control the workshop was moved to a building alongside the new offices [332], and on further protests from De Penning, charge was given to Ernest Gray, a leading watchmaker of Calcutta [124][4], on the grounds that it was impossible to obtain the services of a qualified individual

> among the warrant officers attached to the arsenal, ... and...that...the Revenue Surveys will be at a stand if the instruments...be not speedily repaired, and...Mr. De Penning continuing in charge...interferes with his...more important duties of computer[5] [108–9].

Gray took charge during November 1838, with salary Rs. 350 a month, for a period of six months, and possible extension for a further six months [124, 129]. As Bedford had assumed general charge of the offices at Calcutta from 10th October [325], De Penning could now devote himself to the computing office.

There was now a large and growing demand on the workshop from revenue surveys, and other departments, which the Military Board encouraged;

> The Mathematical Instrument Maker with his establishment should be placed under the Surveyor General, by whom his accounts should be audited, and thus forwarded to the... Military Auditor General. Should the Quarter Master General's Department, or any other department under the...Military Board, require instruments to be made up and repaired, ... this work should be executed in communication with the Surveyor General. ... During the absence of the Surveyor General from the Presidency...the duties...should devolve on the Deputy Surveyor General[6].

Everest, still regarded the Mathematical Instrument Maker and his staff as servants of the Great Trigonometrical Survey, and considered that if the Calcutta workshop was to be largely employed by other departments they should pay for it. Indeed he suggested that "the entire expences...of Mr. Barrow's establishment since the departure of that individual from Calcutta in 1837...may be struck off from the charge of the G.T. Survey, and carried to that of the Revenue Survey[1]". Bedford, on the other hand, did not agree that the whole cost should be debited to revenue surveys, for the work done in May 1839,

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[1] DDn. 342 (57–61), 24–10–37; DDn. 304 (199), 22–3–38. [2] Andrew Amos (1791–1860); barr.; Recorder of Oxford; member of GG.'s Council of 1837–43; *DNB.*; *DIB.* [3] DDn. 304 (217), replying to De P's. note of 27–4–38. [4] deacon of Lal Bazar Baptist chapel; *B Dir* & *AR*, 1843 (24). [5] DDn. 341 (310–1), 27–8–38. [6] DDn. 343 (13–6), 31–8–38.

> so far from being confined to the Revenue Survey Department, was also for the Engineer's, Arsenal, Surveyor General's Office, and the Quarter Master General's department. ... Not one of the articles against which red crosses appear are for the Revenue Survey Department, nor even the whole of the remainder. ... I feel persuaded that the Surveyor General was ignorant of these facts. ... I have nothing to urge against the justice of the principle...that every department pay its own bonafide expenses[2].

Gray did useful work, but found himself restricted, partly from

> the want of turning lathes and proper tools, and partly from my not being able to give my undivided attention to the work, much less to do much with my own hands, and also from the want of sufficient accomodation for the materials, ... a great part of which...are still remaining in the godown...of the Sudder Board of Revenue [332–3]. If Government would make me some further allowance, either as additional salary, or as house-rent, and give me an agreement for not less than two years certain, I would...relinquish my watch repairing business entirely, and retain only the public clocks, and the rating of chronometers [III, 218][3].

His contract was not, however, extended beyond twelve months, after which Boileau took over charge under the direction of the Military Board [124] and the Deputy Surveyor General was relieved of all further responsibility.

FIELD WORKSHOP

Being himself of an ingenious and mechanical turn of mind [III, 440], and having suffered from having instruments damaged in the field, Everest had long ago applied "for a small establishment of artificers" a request that had not been granted [III, 407, 416]. He had now, however, persuaded the Directors to appoint an English instrument-maker for charge of a workshop in Calcutta [122].

When he went up country at the end of 1832, he took with him the "artist" Mohsin Husain, a carpenter, and a blacksmith he picked up on the way [172, 404–5].

> If there be not well trained persons of the kind at hand in the field, I cannot put to rights those parts of the...public instruments which are eternally liable to get out of repair [124]. ... The carpenter...has been thoroughly trained, and I shall not readily meet his like for this sort of work. ... His name is Ram Dheen, and he...is worth...Rs. 15 per month. ... The smith will not accompany my party on any terms, but I shall be able to hire another at Chunar, whom my native artist can train[4].

Within a few weeks of arriving at Mussoorie he asked sanction to construct

> a workshop...of two rooms, one for the two turning lathes and carpenter's apparatus, the other for the smith. These must be built of masonry because the out-houses...being all of grass are very liable to take fire. ...
>
> The native artist...is...of great natural talent as a mechanic, and is able to repair...all the smaller...instruments, and to supply the minor parts of the great instruments. He has a very able carpenter, and a tolerable smith who is daily improving under him, and the department is well supplied with tools, but without a workshop his utility is very much restricted[5].

While he was not allowed a permanent building, sanction was given for the engagement of a number of workmen, and before taking the field in October 1833 he asked Wilcox to recruit at Agra

> 2 Mate Carpenters @ 12 — 2 Mate Carpenters @ 8 — 2 Turners @ 12 — a filemen @ 8 — 1 firemen @ 8 — 2 Hammermen @ 5 — Total Rs. 90. Explain to these people that my workshop opens at 8 o'clock and closes at 5, an interval being allowed from 12 o'clock till 1 for their midday meal. ... You will be very choice in your selection...and get young and docile people in preference to men of fixed habits [404][6].

Under Mohsin Husain these men soon developed into a valuable team, and were taken out into the field every working season. When Barrow came up to

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[1] DDn. 344 (72–4), 21–5–39. [2] DDn. 355 (80–3), 6–7–39. [3] DDn. 354 (150–1), 18–6–39. [4] DDn. 283 (217–24), 24–11–32. [5] DDn. 286 (8–11), 25–6–33. [6] Masuri, 23–10–33; DDn. 321 (58).

Kaliāna in 1837 he was left with half of them as a start. Disappointed that none of the skilled Calcutta men would come up country, Everest asked for assistance from the ordnance magazines [128, 404]. Cawnpore was immediately forthcoming;

> I have this day detached two of the best workmen in brass and iron belonging to the Cawnpore Magazine. ... Their names are Purrowtee and Lulloo; the former is...a brassman, and the latter...a fileman. There is only one other workman more skilful, ... recently recovered from a severe illness which, ... with his advanced age, would in all probability prevent his reaching your camp, or of being of any service if he did arrive[1].

Lumsden, an old friend at Fatehgarh, was equally prompt, sending his

> right-hand man, Jerriaow, the only man of my establishment who could render you any assistance in the...jungle job you have to accomplish. I made enquiries regarding any superior workman who might...serve, ... and found out Motee, who is allowed to be one of the very best of the craft at this place. He was formerly engaged...in the Mint here, ... but as he had a shop of his own in the bazar...I was obliged to agree to his receiving his wages, as well as three men without whom he would not move a step. ...
>
> Do not detain Jerriaow beyond the period when his services can be dispensed with. ... Pray send me a draft for the money advanced, ... and let Jerriaow's family monthly remittance be sent regularly, for never were there such hard times for poor people as at this place at present; thousands wandering about destitute, and many dying from downright starvation[2] [156].

The men from Agra reported back there saying they had found no survey at Kaliāna or its vicinity, but they doubtless connected later.

Pay of the Cawnpore men was remitted regularly, but not so for those at Fatehgarh, who, wrote Lumsden, were on a different footing,

> but, so long as you get Mr. Jerriao's services for the time you require, I fancy you care not a straw who pays him, and all I have to look to is to take care my Superintendent is not debited with his pay whilst you have his services. [Men for Mussoorie] were to bend their steps towards the mountains tomorrow. ... Jerriaow, the smith, has returned, and speaks in raptures of the fine mountain air he enjoyed at Dehra, notwithstanding which the people dislike leaving their homes and families so much that volunteers did not turn out so readily as I should have anticipated.
>
> Several men who only get here $3\frac{3}{4}$ annas per diem for the days they actually work turned up their noses at my offer of Rs. $8\frac{3}{4}$ a month whilst with you[3].

Amongst the instruments made up by Mohsin Husain were several barometer pumps designed by Everest himself [125, 138],

> whereby barometer tubes can be filled in vacuo without danger of breakage. This instrument has...been...tried by me and my friends, Dr. Falconer[4], Lieut. Waugh, and other scientific gentlemen, with great success. Wherefore I caused...to be cast in my workshop all the parts of 6 entire instruments...and hope...to have them worked up into a state of efficiency.
>
> Many other instruments such as heliotropes, lamps, ... have also...been in progress, all... Government property. ... I could not, until the middle of January last, dispense with any of my extra workmen, and am still necessitated to retain the four ablest of the 10. ...
>
> I was in great hopes that his Lordship would in his journey...have passed through Muzaffarnagar, and taken Kaliana on his way, when I am sure he would have been highly gratified at the progress of my native artificers. ... I never had more thorough reason to be contented with the obedience, the assiduity, the cheerfulness, and the activity of my workmen. ...
>
> By far the greater and more important part of the duties for which a Mathematical Instrument Maker was sent out...has been actually performed in my workshop for the last 18 months, and it is impossible that this can have been brought to pass unless my subordinate agents were some of the best people in the world. ... All brass articles which they have as yet turned out have the English finish about them, and are not to be distinguished from the productions of the most celebrated artists of Europe[5].

After his experience with the astronomical circles Everest asked that someone should be sent up from the Mint to

> instruct my artificers in the practical method of casting iron, for they are...eager to learn the art, and...I have little doubt that they would master the subject, and that articles of cast iron would be introduced into general use in the Upper Provinces of India. ...
>
> If the art of dividing could once be introduced into India, the Government...would be able to construct their own instruments...in a style of perfection quite on a par with those in Europe,

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[1] DDn. 302 (134), 15-1-38. [2] DDn. 347 (23-5), 20-1-38. [3] ib. (69-70; 138-40), 12-3 & 22-5-38.
[4] Hugh Falconer (1808-65), Ben. Med., botanist, FRS. [5] DDn. 344 (38-45), 19-3-39.

> all but the glasses and levels, for the operations in my workshop have...proved that natives are equal to the most delicate parts of such instruments, and the process of dividing is exactly that which depends for its success on patient...attention to minutiæ, a quality for which the people of this country are so eminently remarkable[1].

A new lathe arrived from England, specially built for the field workshop,

> prepared with the greatest care, ... complete in all its parts, and embracing numerous improvements...not contemplated in the original requisition ; ... an instrument competent in the hands of an able artificer to the execution of almost any description of work, however complicated or minute, ... and also to the construction of tools and varied descriptions of mechanism[2].

In 1842, after the appointment of Saiyad Mohsin Husain to succeed as Mathematical Instrument Maker, Everest asked that he should be given charge of a special workshop up-country, in touch with the Surveyor General's field headquarters, either at Dehra or Agra, but Government thought he should come down to Calcutta, where all major repairs should be concentrated[3] [125]. Everest protested that

> the Great Trigonometrical Survey has...been provided with a portable turning lathe since 1823 which, together with the requisite tools, has always been carried easily on one camel. ... The repairs which need...a Mathematical Instrument Maker are of diverse kinds, and by far the greater portion...need no lathe at all, but can only be achieved by a delicate and skilful artist. I am quite satisfied of the capability of Seid Mohsin acting under my directions, but it will be a very different affair when he comes to be at a distance from me, under the control of a person independent of my authority, and nominated without my acquiescence.
>
> Hitherto every instrument...has undergone an annual process of examination and cleaning, as also of repairing when needed, by Seid Mohsin under my own eye, and...this is a precaution much too valuable to be lightly rejected[4].

In face of this, Government allowed the Mir Sahib to remain at field headquarters, but ordered his move down to the Presidency on Everest's departure.

ASTRONOMICAL CIRCLES[5]

For the simultaneous observation of the zenith distances Everest insisted that the two observers should have exactly similar instruments [97, 99].

> The two astronomical circles, each with a vertical circle of 3 feet, and an azimuth circle of 2 feet diameter, were taken in hand in 1829 –shortly after I returned from the continent of Europe [III, 446] –by Messrs. Troughton & Simms, and as others of the same kind had been before constructed by the same celebrated artists, it was fair to conclude –...that no hint from me would...improve a form which had been found...to answer the purpose—...and that nothing would be left undone which might promote efficiency. ... Considering the great fame and advanced age of Mr. Troughton, it would be...presumption...to interfere[6].
>
> I suggested...that they should be used with the Great Trigonometrical Survey as long as required, and when that work was terminated should be put up, one at Calcutta, and the other at Bombay, in observatories which it was decided...in 1827 to erect [III, 186–9 ; 191–2].

He further suggested that two astronomers should be appointed in India for this purpose and it was in pursuance of this proposal that Wilcox was appointed as Astronomical Assistant[7] [353–4].

The circles reached Calcutta in 1832, when Everest had time only to set them up and to note a certain unsteadiness that might be remedied by substituting masonry pillars for the wooden tripods. When, therefore, in March 1837, they were first set up at Kaliāna on two such pillars he was dismayed to find that they were still far too unsteady for any accurate work [97–8][8].

With the help of Mohsin Husain he dismantled them and made careful measurements piece by piece. He found that not only were the columns supporting the Y brackets far too slender for the weight of the telescope and vertical circle, but that the horizontal, or azimuth, circle, and the tribrach to which it was united, were both too weak, both in design and construction. Any handling or rotation induced so much vibration—"or rather an oscillation so vast—as to render it out of the power of the astronomer to take an observation with accuracy".

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[1] DDn. 344 (45–53), 21–3–39. [2] CD to B., Mil., 19–12–38. [3] DDn. 401 (154–64), 17–6–42. [4] DDn. 402 (371–86), 15–8–42. [5] *GTS.* XI (24–8 ; pls. ii to iv). Packed for transport the two circles weighed 34 maunds 15 seers, total about 24 cwt ; cost £ 600 each. [6] *MRAS.* XII 1842 (141). [7] SG to Mil. Dept., 12–10–31 ; DDn. 265 (261–91). [8] reached Calcutta 15–8–32.

> The azimuth circle and the frame to which it was united were barely sufficient to sustain the superincumbent weight, and had no strength to spare, so that there existed a springiness in the system which the slightest cause sufficed to call into action. ...
>
> I lost no time in bringing the subject to the notice of the Government, and requesting that the Mathematical Instrument Maker...might be immediately ordered to my headquarters. ...
>
> I now learned for the first time [from Barrow]...that the vibratory motion of which I complained was considered inherent in that class of instruments, as they were what is termed *top-heavy, and...to a certain extent unsteady ; that...Troughton had done all that his skill and experience could suggest to remedy the evil.* ...
>
> As...it did not appear essential that they should be top-heavy, I determined that they should be rather bottom-heavy. ... I would not quietly sit down with my arms folded to take bad observations, whilst there was a fair chance of my devising a method for taking good ones. So I DID devise a remedy, and took immediate measures to have it carried into effect.

The first thing to do was to differentiate between the two instruments by naming one *Troughton* and the other *Simms*, the latter being slightly the more faulty of the two. Detailed drawings before and after reconstruction are given on plates 1 to 5 of the published *Account...of the Meridional Arc of India* [44, 113].

Reaching Kaliāna early in October, Everest had wooden models made, and sent off to Calcutta for castings to be made at the ordnance foundry ;

> The brass table was to be replaced by one of cast-iron, as also the brass azimuth circle by one of the same metal of greater solidity, for all of which Captain Waugh...made the rough drawings...during the two days which the party halted at Kaliana. ... The main difficulty now seemed to be to get these cast-iron tables and azimuth circles constructed. ... I remained... to see the models...completed, ... beautifully constructed by my artificers[1],

He asked De Penning to supervise the delicate work of casting ;

> I have been obliged to leave Kaliana before the completion of the large model, but it...will no doubt soon be got out of hand by Mr. Barrow. ... I beg you will...require the most extreme exactness and attention, for upon the manner in which these casts are executed will mainly depend whether my plan is to end in a failure. ... I stand pledged to perform a radical cure for the disordered state of these instruments, ... a radical defect hitherto supposed to be inherent in instruments of that class. If I fail, I shall have the mortification of being laughed at for my...presumption. If I succeed, there will be an end of the question. ... Succeed...I must if the casts are good[2].

His first intention was to discard the horizontal circles, but he later decided to make new ones of cast-iron, divided under his own supervision.

> These instruments are of the class called altitude and azimuth instruments, that is to say, they have a horizontal circle as well as a vertical circle, both hand-divided, not engine-divided. Now, for...taking observations in the meridian of altitude, the azimuth circle is not absolutely necessary, and my intention is to dispense with it, and substitute a strong cast-iron frame, whereby I shall still preserve the power of reversion in azimuth.
>
> The azimuth divided circles being thus set at liberty, and...beautiful of their kind, will be...converted to the purpose of theodolites, though too weak to bear the great...weight they have now to sustain. ... If I am successful, the State will...gain two large theodolites which could not be procured in England for less than 400 £ sterling each[3].

After two weeks at Kaliāna he had to leave for Sironj [41, 98]. The new brass parts were cast by his own men under Barrow's supervision, but the main pillars were a failure, and had to replaced from Fatehgarh bazaar. Finding other difficulties, and probably much depressed at being left alone in such a desolate place, Barrow appealed in vain to be allowed to take the work down to Calcutta. Everest did not dare to let it escape from his close supervision.

He returned from Sironj on 9th March, and under his vigorous drive good progress was made, and the whole workshop staff, with Barrow and the instruments, moved to Hathipaon for the rains[4].

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[1] *Meridional Arc* (xxxi–iv) ; Report, 3–8–39 (58–70 ; 88–98). [2] DDn. 353 (58–9), 18–10–37. [3] DDn. 342 (54–5), 12–10–37 ; these circles later embodied in Waugh's two 24-inch theodolites ; *GTS.* II ; appx. 2 (15) ; cf. Report, 3–8–39 (81–99). [4] but officially addressed as at Dehra [166] ; cf. Report, 3–8–39 (102–4, 125–34).

De Penning had trouble with the iron castings. He had placed the work first at the Cossipore ordnance foundry and then tried Jessop & Co. of the Phoenix Foundry, and then the Mint. Cossipore eventually managed by working

> in what is called a "loam mould", to prevent the iron from bubbling. ... Two of these fresh castings just clearing away from the mould...seemed to look very well. ... A casting for the lower circle was...still warm in the mould when I last visited the place.

Everest pressed for them to be sent up as quickly as possible ;

> A great deal of time has been already wasted, but for which I might have had the circles all in operation in December next, for the progress...made since I...have had the workshop under my own eye, is much greater than I expected. ... Despatch...all castings—either of the table or lower frame—which hold out a fair chance. ... If at last I get a pair of each to answer my purpose, I will...send you immediate notice to discontinue sending others[1].

De Penning sent off the Cossipore castings and reported in September that

> two more...are in great progress at the Mint. One of them, a very clean cast, and without a single flaw, is already on the lathe and, were it not for the Doorgah Poojah holidays [127 n.5] and two others that intervene, I had great hopes of forwarding it by the next steamer. ... The other cast promises to be equally good and, from the great attention that is paid to matters ...under...Captain Forbes [III, 448], ... I...hope that these casts will be pre-eminently superior[2].

Everest reported at the end of September that

> the two casts for the tables made at the Cossipore Foundry arrived on the 9th June 1838, and though not first-rate have been already turned to account and worked up. ... Of the casts made for the lower circle, two have arrived from the Cossipore Foundry[3]. ... Neither is very excellent, one indeed is extremely rude. ... I should have rejected both without an instant's hesitation if there had been a chance of getting better in any reasonable time. ... I have had one taken in hand, ... the other will remain on the shelf in the hope that something better may come to replace it. ... I have notice of two other casts being in progress at the Mint, and if they...reach me in time, perhaps I may have the gratification of preserving the symmetry and beauty of the instruments as well as their steadiness. ...
>
> I am very sanguine about my plan of dividing, and so are...Lieutenants Waugh and Renny. Mr. Barrow sometimes seems to think it will succeed, and sometimes that it will not [123]. The practical trial will alone set that question at rest[4].

On 27th October the last castings left Calcutta, from the Mint, and from Jessop's ; "the casts from the Mint are very superior, and have been very carefully turned and polished...without a flaw or blemish of any kind"[5]. Everest had found all this delay exceedingly tiresome ; it was inconceivable, he writes,

> how many failures took place ; ... the case...seemed to be quite desperate. ... I had, it seems, applied to the wrong quarter, for the casting of iron at the foundry is very inferior to that at the Mint...under Major Forbes. ... He constructed two circles which would have done credit to the best foundries of Europe, but they arrived too late, for—impatient at the loss of time I had already worked up those received from the Cossipore foundry, taking care to adapt the screws so as to avoid...their diverse blemishes and air holes[6].

He now developed his plan for dividing the new azimuth circles, by making use of one of Troughton's brass circles as a master to be copied, but Barrow turned sour and persistently refused to co-operate. Though willing to re-assemble the two instruments at Kaliāna, he would have nothing to do with the dividing and asked to be released from further service[7] [124]. Pending reference to Government, work was resumed at Kaliāna, and on 12th January Barrow reported that

> the two 3-feet astronomical circles are mounted...in the observatory, and are in working order. As the alterations...have been made under your personal superintendence, except finally putting them together at this place, it is unnecessary for me to do more than assure you that the greatest care has been taken to have every part perfectly sound, but I much regret to add that the vibratory motion of which you complained...still remains[8].

Everest replied, always in writing, that both instruments worked rather too stiffly, which should be rectified before he could accept them. He could not accept personal responsibility, for the blame of all faultiness

> of execution must clearly rest with you. ... You state that...the vibratory motion...still remains.

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[1] DDn. 304 (227), 12 & 27–5–38.

[2] ib. (403), 14–9–38.

[3] taking 38 days from Allahabad to Mussoorie.

[4] to Mil. Dept., DDn. 342 (233–6), 26–9–38.

[5] DDn. 304 (430), 20–10–38.

[6] Report 3–8–39 (126–31).

[7] ib. (130–1) & 302 (146), 6–11–38.

[8] DDn. 302 (149), 13–1–39.

> ... The examination which I have already made leads me to a totally different conclusion. I am...convinced that the plan which I designed has completely counteracted all vibratory motion, except what is inseparable from instruments not supported on stone piers or...masonry[1].

Everest tried in vain to check the spate of acrimonious correspondence ;

> Be pleased, ... instead of wasting time in committing your impertinence to paper, to employ your whole energies in endeavouring to put the instruments into working order, which I fully see is a job requiring all the skill you are master of[2].

With the utmost reluctance Barrow made the final adjustments. Everest made constant critisms on petty matters, sometimes adopting the role of "Superintendent of the Trigonometrical Survey" for the detailed examination of the instruments, and solemnly reporting the results to himself in the capacity of "Surveyor General", who then formally passed the necessary instructions to "the Mathematical Instrument Maker to the Honorable the East India Company".

Not one iota did Barrow budge from his defiant refusal to undertake the dividing of the azimuth circles, and on the 28th January Everest ordered him to Dehra, to await orders. Government had no hesitation in ordering his discharge [124].

Everest was now free to put in hand his scheme for dividing the horizontal circles with the assistance of Mohsin Husain. He had done all he could

> to put these valuable instruments into a thorough state of efficiency, ... and...I have little doubt that they will be free from all unsteadiness. It would give me great pleasure if I could complete the renovation by dividing the azimuth circles, but that...requires a practised workman who can devote his whole attention to the subject, and as my pretensions...are small, and my spare time none, I could...hold out...but a poor prospect of success.
>
> There are but two methods which have yet been successfully tried ; viz., the older system by Bird, which has been by universal consent relinquished because of extreme tediousness, and the method by Troughton [II, 232][3]. A method was proposed some years ago by Capt. Kater [II, 110], which that gentleman assured me had never been fairly tried. ...
>
> Mr. Barrow...tried a method of his own in Calcutta which ended in utter failure, in consequence of which he was necessitated—in dividing the 3-feet circle of the large theodolite—to erase the divisions first engraved, and resort to Troughton's method. I...believe that this was the first occasion of his ever dividing an instrument by hand [142].
>
> The method I proposed is simply that of transferring the divisions of a circle to one not divided by copying from the former. ... Mr. Barrow at first pronounced that it held out every probability of success. Subsequently to 2nd September he promulgated a contrary opinion [123]. ... No shadow of reason has ever been advanced by him for...either opinion. The principle is, however, mathematically quite free from objection. ...
>
> Mr. Troughton's is the only method which can be considered free from doubt, but the apparatus required renders it by far too complicated for me to grapple with it [II, 232][4].

The bold task was carried out in a small building specially built at Hathipaon where it would be subject to Everest's close personal control [166]. The actual execution was entrusted to Mohsin Husain [6, 125].

A brass cradle held the new cast-iron circle that was to be graduated, both being firmly fixed to a masonry pillar. The cradle also carried the old circle to be copied, kept free to revolve four inches above the new circle—the various gadgets for adjusting the relative positions of the two circles—and the cutting tool. Four microscopes were attached to the new iron circle. Everest was particularly pleased with the "stop" designed and constructed by Mohsin Husain,

> an exquisite contrivance, ... as remarkable for its neatness and simplicity as for its efficiency ; furnished with a graduated micrometer head, of which one revolution is equivalent to the difference between the graduating lines of the whole degree and the five-minute spaces[5].

To be independent of daylight, which was uncertain, the room was lit by two Argand burners, shining through panes of glass from the outer verandah.

> The graduation of the first of the two circles was begun on the 6th August, and was carried on under great disadvantages. The method was new ; no person about me had ever seen a cutting tool, or tried his hand, or seen others try their's, at dividing. The weather was most unfavorable ; a constant fog and heavy rain, accompanied by a damp raw wind from the plains,

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[1] DDn. 350 (8–10), 14–1–39. [2] ib. (15), 17–1–39. [3] Troughton's method described in *Phil Trans*, 1809 ; copy sent to Everest by De Penning, 22–12–38. [4] DDn. 344 (5–9), 31–1–39 ; cf. Report, 3–8–39 (164–70). [5] Detailed drawings *Meridional Arc*, II, pls. 4, 5.

> perpetually enveloped the mountain of Hathipaon ; and in the eagerness to grapple with this arduous task many precautions were overlooked which experience had taught others. ...
>
> Though the divisions of each series agreed amongst themselves, yet there was...disagreement between the divisions of one series and another. There was some difficulty in using the cutting tool, for the point could not be kept under sharp vision for the whole length of the cut. This...was overcome by an ingenious device suggested by Lieut. Waugh.

Before commencing the second circle, double doors were fitted to keep the outside air from entering the room. The procedure was revised ;

> The cutter was brought over the point chosen for zero, ... the first [ten degree] division was marked, and the leading microscope then brought to intersect it. All the ten-degree spaces were then set off in succession, ... and the mean reading of the upper microscopes corrected for every deviation exceeding 0·5 of a second. Two microscopes only were used for this second circle, instead of four as with the first.
>
> The ten-degree spaces being thus completed, each was in turn subdivided into degrees. ... The coincidence of the cutter and leader was first established. ... Any error found in the ten-degree space...was divided by ten, and distributed between the component degrees. ... Subdivision down to five minutes was continued on the same principles[1].

When all was finished, a committee was assembled under Waugh which analysed all the readings and made a favourable report ;

> No. 1 [Simms]. ... The graduation is certainly a creditable performance, the errors in the runs of contiguous divisions...having arisen from a deficiency of...procedure, not from any defect in the principle upon which the instrument was graduated. ...
>
> No. 2 [Troughton]...has been divided in a very superior manner. ... The values of the 5-minute spaces agree beautifully between the divisions which define the integral degrees, but on either side of those points there are slight discrepancies. ...
>
> The circle divided by Mr. Barrow in Calcutta[2]...appears to have been executed with a degree of accuracy...surpassing the work of Troughton and Simms. ... There is also reason to think... Circle No. 2...even surpasses the circle divided by Mr. Barrow[3].

The two astronomical circles were at last ready for service, each with

> a pair of new columns, better proportioned and less feeble—a pair of new outriggers and friction rollers—a new axis for the azimuth motion—a new table—and a new circle[4]. ...
>
> My new circles were inlaid with gold to receive the graduations ; at every tenth degree a circular disk of silver was let in that the large figures might stand pre-eminent, and there was sufficient width on the surface of the gold beyond the graduations to admit of the single units being engraved, and still being visible in the reading microscopes[5].

For the figuring Everest sent for the workshop engraver from Calcutta,

> to proceed by...steamer to Allahabad, and thence by...land to Dehra. Einudin will be entitled to...one half additional of his salary from the time of his departure [145–6]. ... If Einudin should object, ... make enquiry for an engraver who will not object, and Einudin must then be discharged, and the consentient party put in his stead on the roll. ...
>
> The Superintendent of Government steamers [142 n.6] will...furnish a passage. ... Cost what it will, the man must come up here, and I will be responsible for any expence[6].

For constructing the copying apparatus, and for cutting the divisions Mohsin Husain was granted an honorarium "equal to £200 sterling, the sum that would be charged for the same work by the first-rate makers in London". Everest himself had

> superintended the division of one of the...circles from beginning to end, ... and though the monotony...was wearisome, ... I exercised a partial superintendence over the other. But then Lieutenant Waugh and Mr. Logan...were present[7].

Thus after two and a half years of anxiety and determination, these instruments were completely reconstructed, and made fit for observations beyond reproach—one of the outstanding triumphs of Everest's professional career.

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[1] *MRAS.* XII, 1842 (141 *et seq*). [2] Lambton's great theodolite [142]. [3] DDn. 378 (757–9), Sept. 1839. [4] GBO. Museum, both Circles with 5 copper plates of detailed drawings *Meridional Arc*, II. [5] *MRAS.* XII, 1842 (141–52) by GE., 11–12–40. [6] to DSG., DDn. 350 (44), 6–3–39. [7] DDn. 402 (82–95), 24–7–40.

CHAPTER IX

SUPPLY OF INSTRUMENTS

Supply and Distribution — Custody — Theodolites — Perambulators — Planetables — Revenue Surveys.

UNDER the old system every surveyor on full allowances provided his own instruments—of any pattern he fancied—whilst the Surveyor General and the Commissary of Ordnance maintained small stocks of the commoner patterns for issue to assistants and to officers on military surveys [I: 203 ; II, 221–4 ; III, 211–5]. These arrangements were not now suitable for the Great Trigonometrical Survey, where instruments had to be of patterns approved by the Superintendent, and many were of his special design. Under Everest's administration instruments were to be stocked by the Surveyor General and issued on Government service.

> It is...very objectionable to let the instruments used be private property, for, 1st of all, the Court of Directors have very liberally supplied my department with instruments for principal as well as minor operations, all but perambulators, planetables, etc., which Mr. Barrow can construct. ... 2nd., ... Surveyors...have been considered to have a prescriptive claim to dispose of their instruments to Government, and so we have at times been encumbered with a vast deal of lumber, ... often disfigured by...fancied improvements. ...
>
> I should recommend...the system which I have established ; ... Gentlemen are furnished with public instruments in a serviceable condition, the decision being left to Mr. Barrow. If the public property has been injured, or is found defective from neglect, gentlemen are themselves liable to pay for the same. If the defect arises from unavoidable accident, the repairs are made at the public expense by the public workmen[1].

Whilst approving this arrangement for the Great Trigonometrical Survey, Government insisted on keeping the old rules for "a Field or River Surveyor", whose allowances covered the provision of instruments[2].

Bearing in mind the trouble that had occurred after Lambton's death, and that experienced by Hodgson in getting a clearance certificate on account of departmental stock and issues [III, 215, 257–8], Everest ordered that

> all instruments...in either division of the department...are to be public property. The Surveyor General has authority to issue...instruments...applicable to the occasion to officers employed under his orders, who are to give receipts for them, and to be responsible...for keeping them in good condition. ...
>
> No officer is allowed to use his private instruments...unless with the express sanction of the Surveyor General, or even to keep such instruments in his possession, without duly notifying that circumstance. ...
>
> At the demise of any officer, ... all instruments...in his possession are in the first instance to be claimed as Government property by the committee appointed to examine his effects, and none are to be delivered to the executors...until satisfactory proof is obtained of their being private property[3].

There were never enough instruments to go round, and De Penning was given authority to purchase on the Calcutta market "any delicate and expensive instrument of the character of a chronometer, which may be urgently required for public service". The normal channel of supply from England was through the Military Board [II, 221–4], which in 1838 recommended that

> the custody of all instruments required in the department of the Surveyor General of India, or for the Revenue Survey, should be vested in the Surveyor General who, as the authority best competent to judge of them, should check and pass the indents. ...

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[1] DDn. 265 (303–8), 10–11–31. [2] BMC. 13–2–32 (120). [3] DDn. 283 (54–61), April 1832.

> A supply of surveying instruments should be retained in the arsenals and magazines to meet demands purely military. ...
>
> The Surveyor General may be authorized, in communication with the Superintendent of the Revenue Surveys, to indent through us on England for such supply...as he thinks necessary, ... but...we think the indents would be more satisfactorily executed if forwarded through Government by the Surveyor General himself. If the Military Board are expected to forward these indents, they should reach their office on the 1st of August of each year...as our indent must be despatched on the 1st October[1].

De Penning was in difficulty after Everest's departure up country when Government ordered him to supply several astronomical instruments to Curnin, formerly the Company's astronomer at Bombay [III, 191–2, 435], and now employed at the Calcutta Mint. De Penning was diffident about making issue without consulting the Surveyor General up country but Government orders were clear, and Curnin was not only impatient, but inclined to be rude. De Penning had to comply, but Everest protested to Government ;

> The instruments which Mr. Secretary Prinsep's letter desires my subordinate to furnish cannot be supplied without injury to the efficiency of my department. Altitude and Azimuth instruments of 18 inches diameter cost from 150 to 200 £ each. I have...as few of them as possible, but as this is the class of instrument chiefly used in principal series of the G.T. Survey, it actually happens that I have not a number sufficient for my purpose. ...
>
> I respectfully submit...the expediency of my being consulted previously to the issue of all large instruments under my charge. ... The discoveries which the late astronomer of Bombay is likely to make in science would hardly repay the inconvenience occasioned by retarding the operations of the Great Trigonometrical Survey. ...
>
> There is an 18-inch altitude and azimuth instrument by Troughton and Simms of great excellence, constructed to the order of Lieutenant Colonel Hodgson, which I can obtain for 1,500 sa. Rs. ... If His Honor in Council should be pleased to allow of my purchasing this... it will be a valuable acquisition, ... and...the instrument which was purchased from Lieutenant Colonel Cheape...[may] be transferred to Mr. Curnin. ...
>
> Should this measure be not approved of...I...recommend that...Mr. Curnin be directed to indent on the Hon'ble Court of Directors for such as he may require[2].

Government declined to sanction the purchase of Hodgson's instrument. Those that had been lent to Mr. Curnin were for a

> specific purpose not admitting delay. ... They were lying unused in the Surveyor General's Office. If the instruments are required for more important purposes...they must be course be withdrawn from him. The period for which he will need them for his observations of the planet Mars will...be confined to the period of that planet continuing in opposition[3].

It is interesting to record the first introduction of familiar implements. In 1831 the Directors called attention to a new description of measuring tape,

> called "Chesterman's self-acting Measuring Tape", which, by means of a spring roller, winds itself up. ... Much time may be saved by this improvement, ... and [we] have therefore sent ...by way of trial—2 Tapes of 100 feet—2 of 50 feet—2 of 24 feet—2 of 12 feet[4].

Chronometers were delicate and contrary [II, 230–1], and, writes Western,

> being taken ill, I gave charge of the chronometer to Mr. A. Torrick on the 15th inst., having first explained to him how to wind it up, and warning him not to let it run down. ... He neglected to wind it up on the morning of the 17th, since which day it has not gone, notwithstanding that I shook it after winding up[5].

Planetables had become cheaper. In 1816 Garling had paid as much as fifty *pagodas*, or Rs. 175, for two. In 1832 Macdonald paid Rs. 12–7–6 for

> a simple Plane-table. It possesses a steady horizontal motion on two concentric brass circles which were turned at the Mint, and is fixed on a firm tripod, each leg of which consists of two branches uniting at the lower extremity, on the French principle[6] [144].

He asked if it might be used for sketching in the detail between his stations, and this was allowed provided it led to "no sacrifice of time or money" [61].

It was obviously with no small degree of self-satisfaction that on his return to India in 1830 Everest asked for the appointment of a committee to report on the highly complicated compensation bars [45–6] and other instruments which he had selected with so much care in England—theodolites of various patterns—lamps—heliotropes—and so forth ;

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[1] DDn. 343 (13–5), 31–8–38. [2] from SG. 4–11–34 ; BMC. 10–12–34 (166–7). [3] BOC. 1–12–34.
[4] CD to B. 26–10–31 (3). [5] DDn. 330 (7), 1–1–33. [6] DDn. 372 (77–80), 1–10–33.

> In the latter end of 1825, when I was about to proceed on sick certificate to England, the Right Hon'ble the Governor General in Council was pleased to recommend...the Court of Directors...to employ me to superintend the construction of certain instruments [III, 242, 260]. ...
>
> The Court of Directors were pleased...at my suggestion to employ Messrs. Troughton and Simms[1], the most celebrated artists in England, instead of Messrs. Gilbert, who usually supply the East India Company [III, 524 ; IV, 149].
>
> In addition to the instruments which the Supreme Government authorized me to indent for in 1825, several others were ordered...in 1829, all of which were constructed by the same able artists under my superintendence. A considerable portion has been brought out by... the two latest ships of the season, quite uninjured by the voyage. ... Being quite unique, and the most perfect of their kind that ever were made, I...request that...public testimony may be borne to the merits of the artists. ...
>
> I am naturally anxious that the Vice-President in Council should know how far I have acquitted myself of the charge confided to me, and...[request] a committee to...report upon the fitness of the instruments...on 1st January next, before which time it will be inconvenient to me to have the instruments properly laid out for inspection[2].

With Sir Thomas Anburey as President [I : 309], the committee expressed admiration at the quality of instruments that were, however, yet to be tested.

On his departure from India at the end of 1843, Everest obtained permission to send home to the Directors samples of the instruments made up by

> the public workmen allowed to me, ... of my own invention. I wish to...take one of each...with me to England as patterns by which others may be constructed. ... 1 Perambulator... — 1 Barometer Pump—1 Apparatus for comparing chains and scales—1 Barometer[3].

Before Bedford could get a "no claims" certificate when leaving India for good, he had to deposit with the Accountant General 4% Government notes to the value of Rs. 2,000, as security for the return of survey instruments issued under his orders to subordinate surveyors [III, 215, 461][4].

CUSTODY OF INSTRUMENTS

During Everest's absence in England, all more important instruments of the Great Trigonometrical Survey, such as Lambton's great theodolite, zenith sector, and steel chains, that were not required by Olliver's small party, were packed safely away in the military magazines at Agra and Saugor [III, 241 ; IV, 152]. On Everest's return he ordered them down to Calcutta by way of the nearest station

> where water conveyance may be procurable. ... The usual mode of transporting the instruments...was that of slinging the cases upon bamboos...borne upon men's shoulders. ... The carriers...should be cautioned on all occasions of setting down the cases to do so with great care[5].

To make room for them at the Surveyor General's Office, and also for the new instruments from England, he asked permission—without immediate success—to transfer to the arsenal all "common surveying instruments" in excess of departmental requirements[6].

The Mathematical Instrument Maker was not responsible for stock and issue, which was normally the business of the Registrar [III, 215 : IV, 140], but which early in 1832 was temporarily passed to one of the new assistants, George Logan, who was ordered to take charge of

> all barometers, thermometers, and other meteorological instruments in store. ... You will receive charge of the base-line apparatus, the 3-feet vertical circles, the 3-feet, 18-inch, 12-inch, 7-inch, and 5-inch theodolites of the new construction ; the reverberatory lamps, the heliotropes, the Drummond lights, and...all the instruments arrived since October 1830. ... These...are under charge of Mr. De Penning, who will deliver them on your requisition.

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[1] Edward Troughton [III, 534]; Wm. Simms [III, 532]; *Emp Svy Rev.*, VII, April 1944 (231–2).
[2] to Mil. Dept. 26–11–30 ; DDn. 265 (88–90).
[3] DDn. 452 (30–6, 59–60), 10–7 & 30–12–43.
[4] BRC. 2–1–43 (10–1).
[5] DDn. 266 (36–9), 16–12–30.
[6] DDn. 344 (102–3), 17–12–30.

> The old zenith sector and the chains belonging to the Great Trigonometrical Survey will likewise be placed in your charge, as also all the chronometers. ...
>
> You will have them...all kept clean and in good preservation, but...none of them may on any occasion be taken to pieces without my acquiescence.
>
> You will examine the whole on the 1st of every month, unless that day falls on a Sunday, when the examination must be deferred till Monday morning. Such of the instruments as are out of order must be taken to...the Mathl. Instrument Maker to be repaired.
>
> You will continue as before to make observations in the observatory, and get the clocks in proper order, and their rates well determined [III, 187][1].

On the move up country, whilst the correspondence office went up the Ganges to Gurmukhtesar Ghāt, some of the instruments were sent up the Jumna to Agra under Murphy, to be handed over to Wilcox for work on the Great Arc [171-2]. Logan took the rest, including the base-line apparatus, to Sahāranpur, where on 20th May he found a letter from Everest ;

> I yesterday received your letter from Meerut. You have acted very judiciously in having the instruments carried on bamboos. I cannot see, though, how you put in practice the method used for the 18-inch instruments, for they were carried on a single pole, palankeen fashion, and had irons constructed on purpose. I suppose you had a pair of bamboos to each case. It would have been the height of folly to run the vast risk of carrying instruments, which have cost so much time, cash, and trouble, on coolies' heads, merely to save a few rupees. The safest mode is the cheapest in the end, though it appears to cost a little more.
>
> I have done all that lies in my power to get the buildings at Saharanpur put in order against your arrival. ... The white ants...are said to be more voracious at Saharanpur than in any other part of India, so much so that men are said to have found their turbans entirely devoured if placed on the ground whilst they were asleep[2].

Logan had to submit quarterly returns of his instruments and was warned that

> if they are stolen or injured in any way, unless it can be clearly shewn that such had occurred in spite of all necessary precautions on your part, you will be liable to pay the full amount at which they are debited in the Accountant General's books[3].

De Penning had to act as general forwarding agent at Calcutta, and reports that he had received

> from the hands of a chuprasi...(who said he came from Meerut), a parcel to my address, *unfranked*. On removing the wax-cloth, I found the parcel (with another cover of wax-cloth) addressed to Mr. Dent, Messrs. Arnold & Dent, Watch & Clock Makers, Fleet Street, London, but without any instructions for my guidance. ... The...parcel...bears the seal of your office.

Everest replied that

> as the chronometer is particularly valuable, not only on account of its intrinsic excellence, but because it was presented to me by the Court of Directors[4], I am most anxious it should arrive safe to the hand of Messrs. Arnold & Dent, to whom there is a letter inside the box.
>
> Have the goodness to take every possible precaution in transmitting it forthwith, as directed, for robberies sometimes take place on board ship[5].

In reply to a request from the Accountant General to fill in a "capital valuation statement" on the instruments held on his charge, Everest protested against having to prepare what was termed "an annual deterioration return".

> In regard to the instruments in use with the Great Arc, ... all of them are in nearly as good order as when issued, ... otherwise they would be ill adapted for the nice work of the department. ... Some of them...have been much enhanced in value...owing to...improvements made... under my superintendence. ... I may adduce the Great Theodolite by Troughton and Simms... as an instance, ... for the...instrument is of much more value at the present moment than when turned out of the maker's shop seven years ago. ...
>
> In the Revenue Survey establishment the case may perhaps be different. ... The instruments in use with Captain Bedford's parties are of less delicate construction, of inferior value. .. Upon such instruments a committee of regimental officers might...pass an opinion, but...the instruments of the Surveyor General's department are of quite another description. ...
>
> In 1830 I purchased at the shop of Robinson in Devonshire Street a small theodolite for the price of 21 guineas. Since my arrival in October 1830 this...has been in perpetual use. From its handiness and adaptation to all kinds of work it is a sort of pet instrument with my

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[1] DDn. 267 (102-3), 28-1-32. [2] Mussoorie, 18-5-33 ; DDn. 287 (24-5). [3] DDn. 499 (3-13), 10-9-33. [4] later presented to RA. Instn. Woolwich. [5] DDn. 331 (24), 11-4-34.

> sub-assistants, who have it out on all occasions in the roughest work, and in difficult situations, yet it is not the least injured, and I could dispose of it at any instant for 300 rupees [144][1]. ...
>
> I should say that the deterioration of an instrument from wear and tear must depend almost entirely on the treatment it receives, and the competency of the party using it. ...
>
> It is utterly out of my power to supply valuation statements such as you have suggested, or Captain Bedford had agreed to furnish. ... I am made a sort of general storekeeper and vendor of instruments for the use of all India, and for persons who are neither subject to my authority nor in correspondence with me[2].

For instruments in regular departmental use one of the senior assistants was made responsible, and in 1836 Rossenrode was directed to receive charge from Mr. Morrison [138, 163] of the instruments borne in the enclosed list, and when the operations of the ensuing season are at an end, you will see that they are all duly delivered back into store. Whenever any instrument is issued to any person whatever, a receipt in due form must be taken. If the issue is only made for...ordinary purposes...to my own immediate camp, a memo to that effect will suffice...in a book which you will keep for that express purpose. ...

> The late decision...in the case of Lieut. Ommanney leads me to suppose that in the event of any loss or injury nothing but the clearest proof of there being nothing left undone on your part will be received as a palliation[3].

When Barrow left Calcutta, responsibility for all instruments in the workshop, as well as those in store, fell on De Penning, and then on the Deputy Surveyor General, till at the end of 1838 the D.S.G. asked that those not required by the Great Trigonometrical Survey, or for current office use, should be transferred to the Fort William arsenal [138] where "there are people who can look after and clean the instruments when required"[4].

The Surveyor General was equally insistent that he should be relieved from responsiblity for instruments beyond the need of his department, which was least adapted for keeping charge of...public property...except such as is in constant use. ... Existing rules were framed...when the Surveyor General was...always at the Presidency.

> The practical inconvenience of the present arrangement is one that has hung over me with the oppression of an incubus. Ever since I left the Presidency I...trust...entirely to my Registrar for the accounts of instruments, and I deem myself fortunate that there are really none for which I cannot account. ... It will seem little short of impossible to keep the current business from coming to a stand, and quite so for the Surveyor General to attend to the business of accounts himself; yet he is the responsible party.
>
> My career is so soon to close that I hardly think it desirable to make any new arrangement to meet my case, for my successor will, it is presumed, be of a different temperament. ...
>
> My Registrar has not...been a person who knew anything whatever about instruments. ... A person with less knowledge on this subject than Mr. Morrison...could hardly be met with anywhere, unless indeed it be in the office of the Military Accountant General, for, with all deference to that functionary, and my unqualified...acknowledgement to Mr. Morley [III, 215] for his unvarying urbanity, I really must say that, weighed in the scale against the clerks...of that office, Mr. Morrison may have very fair pretensions.
>
> I have heard such odd stories of the manner in which the instruments are treated and used by the Revenue Surveyors, and such queer matters have been given to the public in the newspapers, that I confess myself quite at a loss to understand the merits of the case [148–9]. ...
>
> It has long been my persuasion that, considering the great number and cost of public instruments, it would be much for the interest of Government to maintain an establishment whose express duty it should be to have the general custody and superintendence of them, and keep the accounts of receipts and issues[5].

Authority was eventually issued for the transfer to the Commissary General's arsenals of all instruments except those required for the Surveyor General's and the revenue survey departments [138].

THEODOLITES[6]

Practically all the theodolites which Everest brought out in 1830 were constructed by Troughton and Simms. They were—one 3-feet, and two 18-inch, read by micrometers—four 12-inch, twelve 7-inch, and four 5-inch, read by verniers[7].

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[1] Waugh had no use for these Robinson theodolites; DDn. 478 (5), 28–12–45 para 18. [2] DDn. 346 (167–7), 13–9–36. [3] DDn. 371 (75–6), 24–9–36. [4] DDn. 297 (131–2), 5–12–38. [5] DDn. 344 (45–53), 21–3–39. [6] Detailed descriptions by Hennessey, *GTS.* II (appx. 2). [7] reached Calcutta Nov. 1830.

This 3-feet theodolite must not be confused with Lambton's great theodolite by Cary which had been left in India in 1825 [III, 258–9]. The horizontal circle, actually only 34 inches diameter, had been hand-divided by Troughton, and was read by five "flying microscopes". The vertical circle attached to the telescope was of 18-inch diameter. The telescope had focal length 39 inches, and magnification from 49 to 98. Its weight, packed for transport, was 20 maunds 32 seers, nearly 16 cwt. No opportunity of testing it occurred till after the measurement of the Dehra Dūn base-line in January 1835. Then, after Mohsin Husain had rectified several minor defects, Everest declared it to be "as perfect in performance as beautiful in appearance"[1], and wrote to Barrow ;

> I have lately had the large theodolite by Troughton and Simms in practical operation for the first time. ... It is quite a masterpiece. I never imagined the possibility of constructing an instrument which would give terrestial angles so closely agreeing with each other.
>
> The division of the azimuth circles has been so beautifully effected that it is hardly necessary to change the zero. Lateral refraction, errors of observation, the unequal catch of the clamps, and the newness of the friction rollers, appear to cause greater discrepancies...than those which arise from the errors of division.
>
> I found the angles very bad at first, chiefly because the friction rollers of the camel on which the axis is supported had springs of various powers ; one required a weight of 30 lb., one of 19 lb., and one of 14 lb., to overcome the elasticity. ... I remedied this and other little sources of inaccuracy before I commenced in earnest to take the angles, for whilst the camel was in that state the discrepancies amounted to 40 and 50 seconds[2].
>
> Another defect...made itself manifest in this grand instrument. In the bottom of the drum, at the part on which the friction rollers of the camel press, an air-hole made its appearance in the brass, to remedy which I caused a flat circular collar of polished steel to be constructed, and united with screws so as to cover the...part where the rollers traversed. ... When these small matters were corrected...readings were as regular as could be desired[3].

All observations of the principal triangles of the Great Arc between Dehra and Bīdar between 1835 and 1840 were made by Everest, Waugh, or Renny, with one or other of the two 3-feet theodolites. Whilst Cary's was last used in 1866, Troughton & Simms continued in regular use till 1873[4]. It was renovated in 1916 and presented to the Victoria Memorial collection in Calcutta. In 1936, for greater safety, it was enclosed in a glass case together with Lambton's zenith sector [II, 252 ; III, 257, 397]. Hennessey records [140 n.6] that it was "probably the best of all the instruments appertaining to the Survey, and has been most extensively employed"[5].

The two 18-inch theodolites were built to Everest's specification, but, though apparently similar in all respects, writes Hennessey,

> their horizontal circles must have been divided in a different manner, for that of No. 1 has certain large periodic errors...which are not met with in the other. No. 1 has caused great dissatisfaction, but recent investigations have shown that the results obtained...by the systematic method of observation...are really far more accurate than would...appear to be the case. No. 2 is considered to be a good instrument for its size, though decidedly inferior to most of the 24-inch theodolites.
>
> The horizontal circles of both are read by three "fixed" microscopes, placed at 120° apart, and the telescopes have focal lengths of 20 inches, and magnifying powers of 25 to 50[6].

No. 1 was issued in 1833 to the Amua series, and was used there till 1838 when it passed to the Karara series, after being fitted, writes Everest, with a new axis

> on Ramsden's pattern. ... The instrument was reported ready yesterday, and on giving it... hasty examination...I...think that it is in as perfect a condition as the construction...admits. ...
>
> There was a slight parallax observable in the microscopes, ... but I thought it better to leave this for you [Jones] to correct. ... However accurately this might be set at starting, the shaking...on their long journey would be very likely to cause derangement. ...
>
> One complete revolution of each of the bottom screws suffices to raise the axis to its proper height, and there are three dots, one outside the female axis, and one on the circumference of each of the screws, of which all three must be duly placed in line by means of the small square ingeniously adapted by Seid Mohsin[7].

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[1] Detailed description, *Meridional Arc* (cv–ix) ; *GTS.* II (pls. 3, 4). [2] DDn. 289 (222–5), 2–4–35. [3] *Meridional Arc* (cvii–ix). [4] used at 516 principal stations ; *Svy of I. Notes*, 1–8–1916. [5] *GTS.* II (50 ; Appx. 28–33). [6] ib. (51 ; Appx. 61–6). [7] to Jones, 12–11–38 ; DDn. 348 (563–5).

After Everest had friction rollers fitted to the axis bearings to overcome its original stiffness[1], No. 2 was kept for secondary work on the Great Arc.

Cary's old 36-inch theodolite was reconstructed by Barrow in Calcutta[2];

> It might be more correct to say that a totally new instrument was constructed, ... for... hardly any portion of the old fabrick remained, and nothing old was taken entire, the nearest approach...being the application of an old vertical circle of 18 inches diameter[3] of an instrument by Harris, which was of no use where it stood [143]. ...
>
> This 3-feet theodolite was, when ready, a magnificent piece of workmanship, ... with five microscopes to the horizontal limb, and 2 to the vertical circle.
>
> The azimuth circle required to be made entirely new, for which...I had three rings cast... in one of the bazars in Calcutta—... to a model...constructed by Seid Mohsin—of which the best was chosen. ... The principal arrangements were effected under my own eye before I left Calcutta on 24th December 1832, and for the completion of the remainder I left explicit and distinct instructions with the Mathematical Instrument Maker. The instrument reached me when I was in the field in November 1835, and I must do that artist the justice to say that—for excellence of workmanship, accuracy of division, steadiness, regularity, and glibness of motion—and the general neatness, elegance, and nice fitting of all its parts—not only were my expectations exceeded, but...it is as a whole as unrivalled in the world as it is unique[4].

Everest had planned to have both 3-feet theodolites at work on the Great Arc early in 1835, and grew most impatient at Barrow's long delay, mainly due to trouble in dividing the azimuth circle. "When nearly divided I accidentally injured the divisions, and was obliged to erase them by re-turning the face" [134][5]. De Penning reported the theodolite ready in July, but had failed to get it away

> by the steamer...which started on the 1st instant. ... I took the 3 packages to the steam-boat office myself, and called on Captain Johnston[6] for his permission to see the instruments properly stowed away, but he declined receiving the cases, saying that one (containing the body of the instrument) was too large to be admitted into the hold of any steamer, and that he could not safely keep it on deck. Consequently the packages were taken back[7].

Everest had sent a party down to Allahābād to meet the steamer and bring the packages on by road. He was disgusted at the delay and stormed at De Penning;

> You tell me it is with much pleasure that you report the large theodolite completed. Really it affords no pleasure to me to know that an instrument...is completed, if it is without my reach. It were as well at the bottom of the river as far as my operations are concerned. ...
>
> I want to use the instrument in the field on the...1st October, to which end I must have an opportunity of examining...it at my leisure full 10 days before it starts from Dehra, at which place it ought therefore to reach by the 20th September at farthest[8].

It was not till the end of August that De Penning got it accepted for

> the "Jellinghee" accommodation boat for the Western Provinces, to receive goods on the 20th and to sail on the 30th. ... I have been assailing Captain Johnston to receive the instrument on board the flat, and was as often put off, tho' without a positive refusal.
>
> This induced me to examine the flat myself, and I must confess that I despaired of ever sending the instrument by a steamer, as the hold under the beam is much less than 4 feet, whereas the large theodolite in its case stands 4 feet 2 inches.
>
> After much altercation with the Captain of the steamer and Captain Johnston, I at last succeeded in prevailing on the latter to stow the instrument in one of the large cabins on deck, called the captain's dining room, at a charge of 200 rupees. ... Captain Johnston pledged his word that he would assuredly receive the instrument[9].

The *Jellinghee* actually left Calcutta on 5th September, and the theodolite reached Everest at Nojhli on 12th November [39]. After a few minor defects had been rectified by Mohsin Husain, Barrow's renovated instrument was found easier to work than Troughton's, particularly in the levelling of the stand and the reading of the microscopes[10].

To provide for all the triangulation now in hand, Everest had a number of old instruments reconditioned; Cary's 18-inch circular instrument purchased by Lambton in 1810—the twin 18-inch from Madras observatory [III, 259]—Cary's

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[1] DDn. 289 (222–5), 2–4–35. [2] Exbt. Survey Museum, Dehra Dūn [pl. 6]. [3] together with telescope. [4] *Meridional Arc* (cix–xiii). [5] DDn. 307 (35), 12–6–34. [6] Controller of Govt. Steamers, 1833–50 [III, 419 n.4]. [7] DDn. 303 (629), 7–7–35. [8] DDn. 289 (254–6), 23–7–35. [9] DDn. 303 (650), 25–8–35. [10] *Meridional Arc* (cix–xiii).

18-inch, bought from Gray in 1824—Cary's 15-inch[1]—Harris' 15-inch, purchased from Grant's estate [III, 216]—Mohsin Husain's 18-inch [*inf*].

The 18-inch instrument by Cary that Lambton had purchased from England after the accident to his great theodolite [II, 254 ; IV, 16] was the one sold to Stewart for the Nāgpur survey at "the ridiculous price of 525 Nagpore Rupees", whereas it was valued later at over Rs. 2,500 [III, 259, 469][2].

> At the time of the death of Lt. Col. Lambton his property was most precipitately disposed of by auction at Nagpur, on which occasion a valuable 18-inch theodolite by Cary was sold for a sum far below its...worth. This instrument had remained...in the lumber rooms of the Residency at Nagpur ever since, ... and shortly after my arrival in 1830 I applied to the Resident to allow me to take it...for the auction price, which was agreed to. ... Arrived in Calcutta, it was greatly out of order, and required many alterations.
>
> New pillars, new microscope arms, 3...micrometers to the azimuth circle, and two to the vertical, were applied, and...it was sent with Mr. Rossenrode's party [24]...and, on the conclusion of the approximate operations on the Great Arc...1832–33, was delivered to Lieut. Waugh, under whom it was...effectively employed until the 10th April 1837, when in his absence on other duty it was unfortunately burned in the conflagration of the scaffolding at the station of Berona of the Rangir Series [65–6].

It was replaced on the Ranghir Series by its twin which had been used by Olliver on the Calcutta Longitudinal series [III, 264] and had since been refitted.

These theodolites had important defects—First, "the face of the circle is divided not by lines engraved on silver at 5 minutes apart as is now usual, but by dots at 15 minutes asunder"—Second, being "repeating instruments, ... they have one axis rotating within another, whence there is a liability both to unsteadiness and eccentricity, ... stiffness of motion, and all its consequences"—Last, "the telescope of the instrument used in the longitudinal series is of too small power, ... [and] will require new columns to enable it to turn over in altitude"[3].

Gray's 18-inch instrument had been purchased at Rs. 3,000 for the observatory at Calcutta [III, 216]. It had not been used, and Everest found it "top heavy and unsteady" till Barrow's alterations made it "a perfect model of symmetry and compactness"[4]. It was sent out on the Parasnāth Series, but neither Western nor Boileau could make a success of it[5]. It was not well divided, and had very poor levels and telescope [60]. In Waugh's opinion,

> the class of 18-inch engine-divided instruments is not fitted for expensive geodetic operations. ... The expense of a good instrument is infinitely small in comparison to the cost of a survey. The outlay for carriage is the same for an inferior as for a superior instrument, and the work is actually...accelerated by good instrumental means[6].

The 15-inch instrument by Harris had been brought by Grant from England, and had never been a success, nor ever used after his death [III, 216]. Everest had it

> taken entirely to pieces. I reserved the vertical circle for the large theodolite which Mr. Barrow has still in hand [142] and replaced it by a lighter circle taken from a boning instrument by Dollond. ... New columns of a compact form, an entirely new axis, and 3 new microscopes to the azimuth circle, a new lower frame with six pillars, and a new stand were made by Barrow in very able style under my directions, and in lieu of a crazy, rickety, and useless instrument, one was produced...fit to be employed on principal triangles.
>
> I sent that instrument with Lieut. Macdonald...in November last, and when I visited his party in March last [61]. I found it highly efficient, and its performance such as would do credit to the first artist in England[7].

To round off this tale of "cannabalism", witness to the mechanical genius of Everest and the technical versatility of Barrow, we note the 18-inch theodolite constructed by Mohsin Husain in 1840. He made up the entire fabric from local material and graduated the circles, the only portions obtained from England being the object-glass of the telescope and the lenses of the eye-pieces and microscopes. The horizontal circle was furnished with..."flying" microscopes ; the telescope had magnifying

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[1] *GTS.* II, Appx. (71). [2] DDn. 282 (71). 4–6–32. [3] Report 21–8–39 (86–8, 90–5); *GTS.* II, Appx. (68–9). [4] DDn. 286 (13–21), 2–7–33 ; para 6 ; cf. Report 21–8–39 (77–9). [5] Boileau to SG. 21–5–36 ; DDn. 370 (4). [6] TS. 6–6 (6–9), 1–7–48 ; *GTS Syn.* xiii A (4). [7] DDn. 286 (13–21), 2–7–33 ; cf. Report 21–8–39 (80–2); *GTS.* II, Appx. (72).

> powers of 36 to 47. It was a very creditable piece of mechanism, ... and was employed on the Gurwani series, but it has not been used since the 24-inch theodolites became available[1].

The smaller theodolites brought out in 1830 [140] were intended for secondary and minor triangulation, and were invaluable also on reconnaissance, whether "approximate series" or "ray-trace". Everest had offered Shortrede one of the

> 7-inch theodolites with three verniers, an instrument of a very beautiful class, and...with proper precaution it will never show an error of 20″. I have but a few of these, and they are all in the field with me—How am I to convey it to you?—As to the common theodolites, ... I will direct...my office at the Presidency to furnish two, if there be that number in store[2].

One of these 7-inch theodolites was sent down to Campbell on the Salem topographical survey, who found his large theodolite by Gilbert "utterly useless, ... as from the movement of the plates an error is produced of nearly two minutes in every angle" [149][3].

Several of these smaller instruments were issued to the revenue surveys, with locally made "French pattern polygon-headed tripods", which Bedford found "very superior to the unsteady kind at present in use"[4] [137]. Everest had recommended him to ask for the Hon'ble East India Company's pattern,

> made by Messrs. Troughton & Simms, making it an express condition that they be made by those makers alone. Mr. Simms and I put our heads together to devise that form, and...they are a splendid success. They cost too 20 per cent less than Mr. Gilbert's rattle-traps. The six tripods shall be made as requested[5].

Notable features of this Everest pattern were the provision of two opposing vertical arcs instead of a complete vertical circle, and the low height of the telescope standards, which prevented any transit of the telescope, and limited angles of elevation to 30° and of depression to 45°. Thuillier writes in 1850 that they were

> universally sought after by surveyors of the present time. These...are of the most perfect construction, and so admirably adapted for the purpose of the Revenue Survey that too much praise cannot be bestowed on the makers[6].

Of the small Robinson theodolite [139–40], Everest writes to the makers ;

> The little theodolite which you constructed for Col. Colby, ... which I bought at your shop, has turned out the prettiest thing possible. There are some defects...which you must remedy and, if you can do that, I wish you to send out 6 as soon as you can make them. ...
>
> There must be three verniers to the azimuth limb, and the reading glasses...must not be simple lenses, but small microscopes. ... The telescope has not sufficient power, and a larger object-glass would do no harm. There must be some method of turning the axis of the telescope over end for end in the Y's.
>
> Do not think of taking away the bent eye-tube. It is one of the great advantages of the instrument that it can see stars right up to the zenith. There is just room for the head now ; a hair's breadth less would spoil it ; more is not wanted for a careful person. Indeed as I want these instruments more particularly for stars near the zenith than anything else, you must be careful to see that before they leave your shop they are quite equal to that part of the business. ...
>
> Could you...bore the axes of the telescope so as to illuminate the wires from the sides ?
>
> If you can do all these things you will make six of the most beautiful instruments that ever were seen, and I am quite sure that...you will get a sale in India for many more.
>
> The alterations...will, I suppose, not make the price greater than I formerly paid, 20 guineas, ... for then you had only one instrument to make[7].

Everest asked that they should be delivered to "my friend Captain Beaufort", and authorized his bankers to pay the account on hearing from Beaufort[8]. It was probably these theodolites by Robinson which Everest describes as "of the small howitzer description" a stock of which he held at Dehra in 1837 [148].

Shortrede's 18″ theodolite that was used on the Bombay triangulation until 1837 [72–3], had been bought by Jopp from Troughton & Simms [III, 216] ;

> The telescope is about 21 inches focal length. The magnifying power generally employed is 24 ; with this I have seen...a station pole 2½ feet thick and 15 feet long...at a distance of about

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[1] *GTS.* II (51 ; Appx. 67). [2] DDn. 321 (269–73), 25–8–34. [3] DDn. 387 (187), 3–10 & 10–11–37. [4] from Bedford, 27–11–23 ; BTC. 16–12–33 (38). [5] DDn. 301 (84–5), 4–10–33. [6] Thuillier & Smyth (128), with diagram ; Lancaster Jones (71–85) ; *MIO. Price List* 1936 ; 5-inch, Rs. 350 ; 6-inch, Rs. 412 ; makers Thos. Cooke & Sons. [7] 3½-inch and 5-inch transit theodolites by Robinson, Lancaster Jones (73–4). [8] DDn. 282 (392–6), 15–10–33.

> 74 miles. I have seen also the pagoda on Poorundhur from...about 92 miles. The weather in both these instances was no doubt particularly favourable. In ordinary circumstances I have no difficulty in seeing poles at 40 or 50 miles. ...
>
> I have a theodolite by Dollond which I ordered on my private account. The horizontal circle is 15 inches, and the vertical...12. ... This, I believe, you have seen in England[1].

The 18-inch had many serious defects, but could not be replaced at the time[2].

It was later sent to Calcutta for overhaul, Jacob reporting that Shortrede had applied the drastic remedy of a hone "in order to improve the divisions which were slightly ragged. But the experiment...proved a complete failure, as the divisions were made rather less distinct than before". Everest was horrified. "If I had been aware that Lieut. Shortrede had used that barbarous process towards a public instrument, I should have deemed it my duty to...call on that gentleman to pay the cost"[3].

He would not at first consider Shortrede's offer to sell the Dollond for Rs. 2,000 ;

> I remember well the instrument which Dollond was constructing for you, and was always of opinion that it was far too heavy. There is no possibility of changing the zero without lifting it off its stand and, in part, putting it up anew. But the change of zero is...quite indispensable, even with the best hand-divided instrument ; *a fortiori*, it cannot be dispensed with in one engine-divided[4].

No other instrument, however, being available, the Dollond was purchased and taken into use when Jacob took up the principal triangles of the longitudinal series[5], and it was not replaced until 1849 ;

> It...possesed, like all Dollond's instruments, a very fine telescope, but the horizontal circle was one of the first that had ever been engine-divided, and proved of an inferior order. ...
>
> Change of zero was effected...by means of a separate triangular plate of wood, similar to the top of the tripod stand. The feet stood upon this, and on its lower surface was cut a circular groove concentric with the instrument. This rested upon three curved ribs of hard wood fixed to the top of the stand so as to admit a free motion in azimuth. This rude contrivance was found to answer remarkably well[6].

PERAMBULATORS

In spite of pre-occupation with all his geodetic work and high-class instruments, Everest found time to design an improved model of that useful everyday implement the Perambulator. Shortly before he left Calcutta he told Government that he had been considering "perambulators, plain tables, and other instruments which are used in...my department". Whilst there was a shortage of single-wheeled perambulators in store, there was "a great number of double-wheeled ones...supplied of late years by Mr. Gilbert" that were constructed on wrong principles [II, 224].

> Our maps are constructed in miles and decimals of miles, ... but the dial plate of the present perambulator shows miles, furlongs, poles, and yards, and...we must go through a tedious... process of reducing...to decimals of a mile. ... Since a mile is 5280 feet...I purpose that the long hand shall revolve once when the...wheel has been trundled over 528 feet of ground.

He worked out an ingenious series of dials and differential wheels, largely adapted from those of Gilbert's gearing which was to be rejected, and he proposed that the small resulting error should be engraved upon the handle. There should be "a small hand...to shew furlongs for those who are curious about the measures of antiquity"[7]. Early surveyors had, however, been quite happy to keep count in yards, and even furlongs [I : 199]. Brett's pattern had cyclometer reading to fractions of a foot [II, 228]. It was strength and handiness that Everest sought for, rather than change of unit.

He set great store on the design of the small differential wheels, two of which he sent down to De Penning in October 1833 as models for

> the ablest engraver you can procure. If Inuddeen [135] can do them, let him by all means,

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[1] Shortrede to SG. DDn. 323 (48–53), 20–10–31. [2] *GTS*. XII ; *Bo Long*. (vii–21) ; DDn. 305 (119–21), 10–7–37. [3] DDn. 325 (131–2), 30–8–37. [4] DDn. 321 (269–73), 25–8–34 ; *GTS*. XII (vii–B) & SG. to Mil Dept. 2–8–37 ; DDn. 342 (38–9). [5] CD to B. 10–6–40 (9) ; DDn. 343 (312–7). [6] *GTS*. XII (iv-C ; vii-B) ; *GTS*. II, Appx. (73–5). [7] DDn. 283 (213–5), 23–11–32.

but he spoiled a beautiful little micrometer scale for me once, and I would not have these spoiled on any account, because I have watched over their construction with an anxiety which you, who know me, will be able to conceive. ... Great pains have been taken in making the diagram, so pray let the engraved plates be exact copies.

I wish to be engraved on the inner wheel on the three radii...emanating from the centre—"Differential perambulator—Designed by Major Everest—Executed by Seid Mohsin"—On the radii of the outer wheel—"Fore wheel shews thousandths—Back wheel miles and tenths—Masuri, 15th October 1833". If all these inscriptions cannot be compressed on the radii, so as to be done cleverly, each in one line, let them all be omitted, and send the wheels back with only the figures. I know, if any can manage it, you are the person[1].

De Penning got the job done by the best engraver in Calcutta

under my own eyes. ... I herewith enclose the engraver's bill, amounting to twenty-four sicca rupees. The charge is rather high, but I could not engage another to do it for less, Inuddeen, the office engraver, having declared himself incompetent to the undertaking[2].

Everest was not satisfied and sent another pair to be engraved;

The cost of the last...was so extravagant that I am determined to omit all but the mere figures. The engraving must this time be done by the engraver of the office. ... If he is not equal to that he is really unfit for anything whatever. ...

My object is to cheapen the perambulators to Government, and...I got the measuring wheels made at the Gun Carriage Factory at Futtehgurh for nothing. But, if 24 sa. Rs. is to be charged for the engraving, it will be no saving of expence. If my engraver spoils these, I shall make him pay 20 Rs. for each pair...and if he cannot do them himself, he must pay some other man for doing them, or be discharged[3].

This time the engraving was successful and, writes De Penning,

Inuddeen would have undertaken to engrave the former...dials, ... but as you expressed a wish to have it very neatly executed and, the space...being very limited, Inuddeen got alarmed, and was afraid to undertake it[4].

Having completed two of his new perambulators to his satisfaction, and tested them on the ground, Everest sent one down to the Military Board;

The measuring wheel is made very heavy in order that it may be pleasanter to the native who conducts it on the ground than to carry it on his shoulder. ... I tried one of these perambulators against the measuring bars last year in the Dun when I was...measuring a base of verification. ... The wheel is larger than it ought to be by 0·844 of an inch, an evil to which every perambulator is liable, and for which a correction ought always to be applied[5].

He built a number in his own workshop at Dehra Dūn, but found none to surpass the two first made up at Fatehgarh for "strength, durability, and accuracy". It was with great pride that he presented two of the new perambulators, one to the Commander-in-Chief, the other to the Governor General. A special feature was a "puzzle lock" for the box covering the dial plates and gears. That inscribed for Sir Jasper Nicolls opened to the word "delay"; that for Lord Auckland to "thick"[6].

Everest's design was warmly praised by Wroughton, the revenue surveyor;

During the past month I have given it several trials. ... The construction...appears to me excellent, and infinitely better...for the revenue surveyors than any...ever used by me. It possesses solidity and simplicity, and when used in a champaign country produces results differing in a very small degree from those...from a good chain. ...

If your wheel could be reduced in size...its utility on these surveys would be great indeed. ... The wheel should have a circumference of 6·6 feet, and if the graduated circles of the dials be divided into 100 parts we shall gain lightness and portability, ... and by using decimals have no more calculation than if the wheel measures a single yard.

Everest much appreciated Wroughton's interest, and saw no reason why another pattern should not be designed with Gunter's chain as unit;

I must not lay claim to an invention. ... Mine is the mere modification of a principle which has existed...in the Madras perambulator [III, 219]. I intended this instrument chiefly for route surveys, and what we call Ray Tracings [78–81], but...it is perfectly easy to apply the same principle to any other element—...as 660 feet—and diminish at the same time the diameter of the wheel and weight of the instrument. ...

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[1] DDn. 287 (181–2), 16–10–33. [2] DDn. 309 (119–20), 11–12–33. [3] DDn. 316 (127–8), 7–7–34. [4] DDn. 307 (13–4), 8–8–34. [5] DDn. 346 (85–8), 5–5–36. [6] DDn. 402 (9–13), 29–2–40.

I never could bring my mind to...what the...acre has to do with...India. Its introduction appears...to involve a cumbersome system where simplicity is a great desideratum. ... However, this is, I suppose, irremediable now. ... 660 will do just as well as 528[1].

The acre had been forced on the revenue surveyors by the lack of any standard value of the *bīgha* or other local unit of superficial or linear measure. It was thought better to accept the standard yard and acre than to assume some arbitrary value for the *hath*, *gaz*, or *bīgha*, for which no agreed standard existed [III, 163-5].

The perambulator was a popular subject for experiment, and Mathison writes of a new pattern designed by John Boileau, which was not so durable or useful as the old-fashioned Madras pattern [I: 199; III, 219], though the latter, "being graduated to yards, ... is...apt to puzzle the native surveyors, who have to record their accounts in chains and links"[2]. A few years later Waugh brought out yet another pattern. He found "Colonel Everest's wheel is very strong and the perambulater useful. The only defects are the axle is too slight and the dial a little too small to be easily read off[3]".

PLANETABLES

Though planetable survey found no part in Everest's programme, he encouraged its use as an aid in triangulation reconnaissance, and for laying down the general features of the country covered by his triangulators [61-2]. He has left the detailed specification of a planetable made up by Mohsin Husain, which with slight modifications remained the standard Indian pattern for the next 100 years.

The best sort of plane table is a rectangular teak or toon[4] board of any convenient size. ... formed of four pieces 6 inches broad, in the centre of which a piece is let in to prevent warping. ... Underneath the board is firmly screwed a brass circular plate...from the centre of which a large male screw...projects, and which has a nut or thumbscrew. ...

The stand consists of three teak-wood legs, having shoulders to unite...below the table. ... They are fitted with brass ferrules ; ... in these an iron spike is run to form the foot. The heads...have brass ferrules, and are fitted with screws etc., the same as the best theodolite stands. They fit on a piece of brass fashioned to receive them—in the shape of a T. ...

A circular hole is bored in the centre of the T to receive the large male screw of the board, which should fit in very exactly...so that the large male screw being put through the hole in the stand, and the nut screwed on below, the table may be placed horizontally by the legs, and may be moved horizontally on the stand, and firmly fixed in any desired position by screwing fast the nut below the legs. ...

This table differs altogether from the common sort made with a ball and socket. It can be made by any common blacksmith and carpenter, and will be found very exact in its adjustments and not liable to get out of repairs.

The best sort of index (sight rule) is a common flat boxwood, mahogany, or teak, ruler, ... having sights fixed on its ends, ... with double apertures in each, and the line of collimation in the same plane as the levelled edge of the ruler. This index, or ruler, ... serves to draw rays to objects, and is far preferable to any made with telescopes.

In the absence of a compass, the meridian...may be found by sticking a piece of wire vertically above the board, at 12 o'clock precisely, ... as the shadow will then indicate the true meridian very nearly [149-50]. ...

A common pocket compass may be useed, ... a magnetic needle set in a small mahogany box...having a card in the bottom, or a needle suspended, ... having only the direction of the meridian marked in the bottom. ... These must never be attached to the side of the table to render it lopsided, but placed on the board, and a small rectangle traced round the box with a pencil, in which the box is to be placed whenever the needle is required.

Then follow detailed elementary instructions for mounting the drawing paper on the board "stretched perfectly even", and for measuring an angle on the board "within two or three minutes of the truth"[5].

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[1] DDn. 403 (249-56), 26-8 & 7-9-40. [2] DLR. 37/48 (56), 31-5-42. [3] DDn. 493 (284), 28-3-50.
[4] teak=*tectona grandis* ; toon=*cedrela toona*. [5] DDn. 472 (278-80), 10-12-39.

REVENUE SURVEYS

During the short interval between Herbert's departure to Lucknow and Bedford's assumption of the duties of Deputy Surveyor General at Allahābād, administration of the revenue surveys fell on the Surveyor General, and Everest had to determine a policy regarding the issue of instruments to that department. He found that under existing rules free issue could only be made to officers of the Quartermaster General's department, and to "assistant surveyors, being European commissioned officers". Surveyors in charge of revenue survey parties had to pay for their own instruments, though "the prescribed proportion of common instruments" would be supplied "for the use of the apprentices" [III, 213 ; IV, 136].

Being directed to send a stock of instruments up to Allahābād, Everest assembled a committee to advise him, and only sent what it considered essential. On taking over charge Bedford found that he would require a further supply of about 100 Gunter's chains, 25 theodolites, and as many surveying compasses. Whilst Everest suggested that chains might be made up in the *bazar* for about Rs. 5 each, Bedford asked for a cheap make of theodolite for "village surveys" ;

> I allude to the most simple kind...with graduated limb, a vernier reading off to about 3′, and two upright sights like a Compass or Circumferentor. These might be made to any extent...by the Company's Instrument Maker in Calcutta, and answer...both for details and boundaries. I have tried this instrument myself, and know that a round of several miles may be closed with an error of from 10′ to 20′, which...would not materially affect the closing of the traverse. Two of these simple theodolites were made over by myself to Major Schalch when on my way to Assam [III, 52–3] and may still be in the Surveyor General's office[1].

He liked Everest's new "howitzer" pattern [144], and asked that

> 5 theodolites (4-inch diameter with double telescope) of the new construction by Robinson, brought out by Major Everest, be allowed to each survey ; also six of the plainest kind without telescope...as used by General Roy for the smaller portions of his survey. These would replace the prismatic compasses now in use, and be available for minor operations[2].

For the new parties taking the field in October 1833 he wanted

> as far as 5 Theodolites and 10 surveying compasses. ... 4 theodolites at Allahabad are all...I have been able to procure beyond the limited supply from the Surveyor General. I know of several... for sale, and two at a moderate price ; ... viz., one for 300 from the Commissioner of Delhi, and a second belonging to Lieutt. Fraser for 350. Captain Colvin has also a superior theodolite for sale, but at a high price, 500 or 550 rupees.

Purchase was sanctioned and Bedford indented for 12 more "of the plainest construction...for the boundary work of common-sized villages"[3].

He arranged for a special small sized case of instruments for revenue surveyors as those stocked by the ordnance contained many unnecessary articles

> liable to be mislaid or injured. I would recommend...that four complete cases only be issued ...to each survey, ... and that 100 small cases be made up...to contain...2 pairs of common compasses...—1 pair of bow compasses with steel pen—1 drawing pen with pricker...screwed into the handle—1 rectangular 6-inch brass protractor. The above...will not probably cost above 16 rupees, instead of from 34 to 91 rupees, the value of these now in use[4].

Everest thought it most unfair that revenue survey instruments should be sent to his workshop[5], especially when Bedford asked Government that one lot

> should be repaired and despatched from Calcutta at latest by the 1st September next. I have already requested Mr. Barrow to lay aside (if necessary) all other articles, ... and to give his whole spare labour to the rectangular protractor and instruments, ... but as he is not under my control, ... I...request that strict orders be given to Mr. Barrow, through the proper authority, for their repair and despatch by the time above specified.

As these instructions were passed direct to Barrow without advice to the Surveyor General, Everest was most indignant [122–3] and suggested that the whole cost of the workshop might as well be charged on the Revenue Survey department [128–9], whilst the Governor General remarked severely that the instruments employed in the Revenue Survey department appear to be frequently getting out of order which...it is supposed must arise from a want of proper attention in the use of them. ... Some check should be applied...as may...diminish this growing evil[1] [140].

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[1] BTO. 4–12–32 (197). [2] DDn. 305 (61), 23–1–33. [3] BTO. 16–12–33 (36–8). [4] ib. 26–8–33 (27). [5] ib. 15–2–33.

The Directors enquired two years later whether "the evil has since been corrected" and we may be sure that the answer was in the affirmative.

In January 1835 the Military Board [136] sent home an indent providing for "twelve distinct land revenue survey parties" [214], and this number of prismatic compasses, theodolites, and Hutton's logarithm tables, came out early in 1836. A year later the Directors advised the shipment of eight cases containing

9 Theodolites, 4 inches, (2 Telescopes each)
18 Prismatic compasses, with stands
60 Chains, measuring, and arrows, 100 feet
12 Perambulators
36 Cases Mathematical Instruments
18 Rulers parallel, with rollers, 6 inches
36 Scales brass, for plotting, 6 inches
18 Telescopes with slings
50 Chains measuring, and arrows, 66 feet.

These, with the exception of the theodolites (nine more of which we will transmit...as soon as practicable), and the telescopes, ... complete the indent...and will, we trust, enable you to prosecute the important surveys, both in the lower and western provinces, with vigour and efficiency. ... One half of the indent has been furnished by Messrs. Troughton & Simms, and one half by Mr. Wm. Gilbert, and we desire...the Surveyor General to report to you on the relative qualities, ... particularly the theodolites[2].

With his next indent Bedford reported "the unserviceable state of Gilbert's theodolites", and strongly recommended that

the present indent be supplied entirely by Troughton & Simms, whose instruments are not only procurable at a moderate rate, but of a quality so superior as to gain the confidence of every surveyor who has used them[3].

The Directors thereupon struck Gilbert off the list ;

Mathematical instruments forwarded by us to India have always been received upon the good faith and responsibility of the makers. From the dissatisfaction...expressed on more than one occasion (supported by a return to England of some of the defective instruments for inspection and readjustment), we had some time prior to the receipt of the present despatch discontinued our orders to Mr. Gilbert, and we will take care that the parties who are now entrusted with the supply shall furnish only instruments of the most approved description[4].

The large increase of establishments in 1837 threw a great strain on the supply, [215-7] and Wroughton protested against "the impression that a surveyor is expected to find his assistants in instruments. ... Endless destruction has befallen my private instruments from allowing the assistants a free use of them[5].

Revenue surveys were largely carried out by magnetic compass, and the Commissioner of Patna[6] became greatly interested in magnetic declination ;

The professional survey having been brought nearly to a close in the Lower as well as the Upper Provinces —...before the detail records...are consigned to the lumber room, and become food for the white ants—I would...rescue from oblivion the observations made by the different survey parties...with a view to the formation of a map showing the variation of the needle throughout India.

He forwarded a paper on the construction of "a Portable Meridian",

a small instrument which I have contrived for laying down...meridian lines, for ascertaining... the variation of any compass, the latitude of any place, and the correctness of any watch. The instrument has met with the approval of the experienced revenue surveyors, Lieutt. Thuillier and Lieutt. Maxwell.

He asked that one should be made up for him at the Mathematical Instrument Maker's workshop, and tells how he found his inspiration ;

Those who have visited the Cathedral of Florence, or the Church of Saint Petronio at Bologna, may recollect...a straight line running down the whole length of the aisle, and a small round hole in the wall...about 50 or 60 feet above...the pavement.

A traveller who should enter...about noon would not fail to be struck by the mysterious conduct of those about him. A dozen watches of quaint forms and various sizes would...spring suddenly from the fobs and waistcoat pockets of people as quaint and peculiar as their timepieces. Their eyes would...be intently fixed on some object on the ground, and the traveller would naturally imagine that the toe-nail of a saint...was about to perform a miracle, the exact period of which it was as important to fix as that of the transit of Venus. ...

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[1] DDn. 305 (265-6), 6-10-38. [2] CD to B., Gen., 1-3-37 (1-3). [3] from Bedford, 27-4-38 ; BTC. 12-6-38 (218). [4] CD to B. 10-6-40 (3); DDn. 343 (312-7). [5] DDn. 301 (192-5), 15-11-37. [6] Edward Cockburn Ravenshaw, BCS., Comnr. Patna 1840.

The traveller would find that the object of solicitude was a bright round spot caused by a ray of the sun passing through the aperture, ... which is seen slowly approaching the line that runs down the centre of the aisle. This line is a meridian, and when the bright round spot arrives at, and is bisected by, this line, the sun intimates...that he has reached his meridian altitude. The watches are returned to their fobs, and voices are heard muttering in Italian, German, French, and English, either self-congratulations on the accuracy of their Bregnets, or uncomplimentary remarks upon the artists who manufactured their watches.

I have constructed a small instrument, ... diameter 9½ inches, and the height of the... gnomon 2 inches. It is made...of brass, and the degrees on the rim have been marked off with great accuracy by a native mistry. The cost of the materials is not more than 2 Rs., and the labour...considerable, and the man asked 16 Rs. for the whole, including his own remuneration. This, however, is cheap compared with some of Dollond's Universal Dials, 4½ inches in diameter which in Calcutta cost 80 Rs.[1]

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[1] from Comnr. Patna 7 & 11-4-43; Ben Govr. Progs. 17-7-43 (13); *JASB.* XII, 1843 (318-41, 1112); diagram p. 442; Ravenshaw says nothing about Equation of Time!

CHAPTER X

HUMAN CONTACTS, GREAT TRIGONOMETRICAL SURVEY

Civil Aid — Clearing of Trees — Inhabitants — Mussoorie — Dehra Dūn — Travel & Transport — Medical Aid.

WE have already told of difficulties encountered by officers of the Great Trigonometrical Survey when working through wild outlandish parts of south or central India, difficulties aggravated by constant moves from one district or State to another, often through areas where supplies and transport were difficult to obtain, however friendly the inhabitants. Occasionally local headmen and villagers were definitely unfriendly, regarding the surveyors as intruders, and their habit of occupying prominent hill tops or conspicuous buildings as unwarranted trespass [II, 369–72 ; III, 412–5]. In some cases the local people were so resentful that they destroyed the signals and marks at the first opportunity [86, 161].

Now under Everest's rule operations were being carried out on a much wider front, and often in densely populated areas where it was difficult to avoid interference with the daily pursuits and property of the villagers. Every attempt was made to win friendly co-operation. Notice in advance was sent to local authorities, who were generally very ready to assist, especially with local guides and *chuprāsis*. It was, however, impossible to give prior notice of day to day movements, and there were bound to be occasional disappointments and delays.

Squabbles sometimes occurred between survey followers and villagers, and complaints to the magistrate did not always bring support for the surveyors. Peyton found the inhabitants of a Hooghly village decidedly hostile.

> Sheo Singh sepoy and Gunes classee were most unmercifully beaten. ... The whole affair... originated from the sepoy merely enquiring of a villager the route he was to pursue, and the answer being sullen produced the affray, in which the whole village joined and beat them most severely. ... The Darogah...seized the principal persons of the village and sent them to the Magistrate at Hooghly, I being also obliged to send the sepoy and classee, besides two of my servants who were witnesses, ... bearing my complaint with them. ...
>
> One of our tree stations in the village of Kumalpoor...has been insultingly cut down[1]. ...

The magistrate decided that the survey followers had been the aggressors, and Everest declined to interfere ;

> The Great Trigonometrical Survey should...avoid disputes, ... and this can never be... without all those who are in charge of parties preserve the most perfect good humour and patience. ... It is a mistake to suppose that the inhabitants are hostile. ...
>
> In my late journey to inspect the tract for the base-line [48] some of my people were beaten by the inhabitants of one of the villages and, finding on enquiry that they were the aggressors, I was rather pleased with it than otherwise, because it saved me the trouble of punishing them myself.
>
> I was for several days without any perwanah [II, 42 n.2 ; III, 408 n.2], and though the natives were at first rather shy of affording me any assistance, yet long before the authority arrived, I had succeeded in making them as obliging as could be desired[2].
>
> It is impossible to enter into any dissensions with those in authority unless we are decidedly on the right side of the question. Govt. will very naturally support their own magistrates... and it would be most imprudent...to request them to support my subordinates where...as much offence had been given as received[3].

It was made absolutely clear that the free consent of a ruler had to be obtained before survey could be carried into his State. In 1832 "the Raj Rana of Kotah" protested against his territory being surveyed by an officer of the Quartermaster General's department. The Political Agent stopped the survey on the grounds that

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[1] DDn. 173 (208-10), 29-1-31. [2] DDn. 267 (54-6), 11-2-31. [3] DDn. 173 (215), 22-2-31.

> it is perfectly competent to the Raj Rana to prohibit the prosecution of such a survey. ... I rest not merely on the general principles of justice and of international laws, but also on my own personal knowledge of a case in point which occurred at Bhurtpore while I officiated there in 1829, ... having been commanded by Government to desist till the permission of the... administration should be obtained [III, 26].

While Government endorsed the action of the Political Agent, they asked him to "use his utmost endeavours to impress on...the Raj Rana the advantages of the survey, and the propriety of his affording his sanction"[1].

Before sending off Rossenrode to carry the approximate series of the Great Arc northwards from Sironj, Everest asked Government to warn the Political Agents of Bhopāl and Gwalior, and to ask for special protection ;

> Without...Government being manifestly in support..it would...be useless to make the attempt, ... for the country...is overrun with robbers who attack parties in open day. ... Even the public instruments, when travelling on the high road for deposit in the Agra magazine in 1825 [III, 245], were assailed by a body of banditti, who were driven off...by a superior force. ... Parties with flags could not safely be detached to...the stations if there existed the smallest doubt as to their acting with the full consent of their own and the local Government. ...
>
> It is indispensably necessary...that a party of the Goonah Horse[2] [III, 447] should be sent with them. It was mainly owing to the presence of such a party in 1825 that my people were enabled to beat off the banditti who attacked them. I propose detaching the regular escort of the Great Trigonometrical Survey, consisting of 1 havildar, 1 naik, and 12 sepoys with Mr. Rossenrode, ... besides...a party of 12 burkandazes[3].

After Everest had joined Rossenrode, the Resident wrote that he could not ask

> this Government to send supplies of water, etc., to the summits of hills. I...suggest that your parties...purchase provisions, etc., at the villages, ... and...hire camels and men, ... or that you authorize me to pay to the Court the sums expended in complying with your request.
>
> The Court will erect their flags wherever you may direct, but the people have great objections to the admittance of parties into turrets or high buildings, for they imagine that our instruments expose their females and female appartments, and the higher classes would sooner sacrifice their lives than submit [163]. ...
>
> I should have been most happy to have had the pleasure of your company at Gwalior[4].

Everest replied a week later, after moving on from Gwalior ;

> Your letter...was put into my hand just as I was mounting my horse to quit your hospitable roof, and my first business is to beg you to accept my thanks for the ready civility of your people, and their attention to the comforts of my brother [33], Captain Wilcox, and myself[5].
>
> It is not requisite for the Court at Gwalior to incur any expence, but it is indispensable that water should be carried to the summits of the hills. ... The head of the party has strict orders...to pay everybody who is employed at such rates as the talookdar...may decide. ...
>
> Although the villagers are inoffensive, and rather disposed to be obliging, yet the men in authority, with their sword-and-shield followers, shew a considerable...ill-will. At Eesagarh... the rudeness of the Pundit Killadar was manifested in various ways. Seven years ago my people were freely admitted into the city, and encountered no opposition, ... but, although... the main road lies through it, my people were, when I was there, turned back with insolence, ... and on one occasion...Mr. J. Olliver found the bridle of his horse suddenly grasped by one of those armed ruffians in the public path. ...
>
> The only real exception I have as yet met with is in the Rajah of Pahargarh, ... who received me with extreme hospitality, ... and invited me to visit his fort and palace.
>
> In respect to furnishing provisions at the tops of hills, the plan...has been for the talookdars...to direct that a buneeah shall proceed to the spot, and vend grain or other articles at such prices as will remunerate him for his trouble and the expence of carriage[6] [III, 245].

Further east, passing through Bundelkhand, Macdonald writes that he

> at first met with opposition from the inhabitants...subject to Sandia, but having received a visit from the Mahratta Kamadar, or ruler of the province, I obtained from him a promise that no objection would...be made to our occupying any position that may be selected for stations, and the tributary Raja has also intimated his intention of preventing...any hindrance[7].

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[1] DDn. 284 (55), 10-4-32. [2] Goonah, nr. Deadheri HS. [pl. 4]. [3] DDn. 283 (155-7), 15-9-32. [4] DDn. 284 (273-5), 2-4-33. [5] Resident was obviously away on tour. [6] Futtehpoor Sikri, 9-4-33 ; DDn. 287 (8-9). [7] DDn. 373 (20-2), 1-5-33.

Everest was so eager to get moving, counting every moment of his time, that he could not bear to be kept waiting by others, and had no sympathy whatever for excuses put forward for the slightest delay in meeting his demands. His impatience was almost uncontrollable, and time and again he rushed into fierce denunciations against those who failed him. He protests to Government, far away at Calcutta, after a delay of three days in starting out for the field ;

> The whole of my establishment have been waiting in the Dhoon since the 1st November, and...no elephants having yet arrived it is impossible to proceed with my business. ... Punctuality is the very life and soul of my department, and...whenever I specify a day, it is with the intention of abiding by it. My people are all habituated to this method, and whenever I have only myself and them to rely on, the rule is sure never to be infringed.
>
> Delays incurred by other departments, therefore, have the most injurious effect on an orderly department...where economy of time is of incalculable importance. It is to be feared that 10 days at least of the most valuable season of the year will on this account be passed in inactivity, and those ten days are worth 50 at any other season[1].

The strain thrown on a sparsely populated district by the invasion of a survey party is well illustrated by the following letter from Waugh to the Agent to the Governor General in Bundelkhand [II, 371] ;

> Observations proceed night and day, ... at all hours when the state of the atmosphere will permit, and it is...incumbent...to encamp on the summits of the hills, close to the stations of observation, ... frequently in the midst of jungle, and far remote from scenes of cultivation and all sources of supply. Provisions, water, grass, fuel, are...all drawn from some distance.
>
> The coolies...for...building platforms, felling jungle, cutting roads, etc., are paid at the usual Government rate of 2 annas per day, and are always willing to work, but...at times... are withheld by the...authorities.
>
> The whole of my party are in efficient marching order, and independent of...aid in the way of conveyance. Our marches are not confined to roads, but we generally pursue cross-country tracks and the shortest routes. ... The party...consists of about 200 men, with about 50 head of cattle, and...the provisioning of such an establishment for any length of time in jungles remote from cultivation is a source of...anxiety.
>
> Parties are always detached in advance in occupation of eligible spots of observation. ... Directly a station is chosen a large flag is raised during the day, and large fires called holies burnt during the night as signals [27, 161]. ... These movements, of course, appear singular to the natives. It is of importance they should view them without...alarm or a hostile feeling. ... Detached parties are also left...in rear. ... These must all act simultaneously by signal, and any accident...deranges the whole system.
>
> The stations are all marked by a stone with a circle engraved. ... These stones should not be removed, since the survey must in such a case retrace its steps. This accident has occasionally occurred, ... and caused a heavy expence in the repetition of the work [III, 245 ; IV, 86]. ...
>
> Chief authorities have usually issued instructions...to render us every assistance, and explained the peaceable nature of our views. We have also been furnished with purwanas to the same effect as a warrant for our proceedings. I beg...a similar favour from you[2].

By April 1834 Everest was coming to the end of a most exhausting field season, having coaxed his triangles across the flat congested Jumna plain, and he writes from Chāndni Pahar near Hardwār, appealing to the Superintendent of the Dūn, Frederick Young[3], to give him every help in his last effort across the Siwāliks [37].

> I am engaged in exploring the lower range to the south of the Dhoon, and have three parties out, seeking for some points to connect my triangulation in the plains with that to the northward. My people complain sadly of the want of provisions and of aid in every shape. I have a letter today from...Mr. Olliver, whom I detached 3 days ago to a high ridge near Kasrao Ghat. ... On the ridge...my large instrument must shortly stand, and where the instrument goes I and at least 150 followers must also proceed, and remain until the requisite number of observations is completed. ...
>
> The work must be done, and we must be fed. ... The weather is passing hot, and passing stormy, and will daily get worse and worse, and—seeing, moreover, that I am nearly worn out with toil, and that my health is suffering—I pray you, like a good Samaritan, to give me all the aid in your power. I want purwanas. I want 3 chuprasis to be placed in attendance on

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[1] DDn. 286 (105), 4-11-33. [2] from Ranghir Series ; DDn. 322 (19-23), 26-11-33. [3] (1786-1874) ; Comdt. Sirmoor Batt. 1815-43 ; PA. Dehra Dūn, 1833-42 ; Williams (51) ; bio. by dau., L. H. Jenkins, London, 1923.

my camp. I want you to send precise instructions to all the local authorities in the Dhoon to give me all the assistance...that it lies in their power to render[1].

Two days later he wrote stiffly to the magistrate at Sahāranpur ;

> My camp came here on the 4th, and on the evening of that day more than half the people went without food. I thought this might have been accidental, but it has occurred almost every day since, in a greater or less degree, and yesterday...a quantity of unwholesome ottah[2] was sent, which the people could not use, famished as they were.
>
> I received a reply from the tahsildhar of Mualapur...that his jemadar at Hardwar and 4 chuprasis had been in constant attendance, but this is an utter falsehood. ...
>
> Furnished...with general purwanas from the Commissioner, and holding a high and responsible office emanating immediately from the Honorable Court of Directors, I might reasonably be entitled to expect that the Tahsildar would himself have waited on me...to pay his respects. ... The only notice he has taken...is to send one poor chuprasi, ... a willing creature enough certainly, but totally unable alone to insure the regularity of supplies to my camp. ...
>
> My camp will move from here on Saturday towards a station near Kasru Ghat...where my supplies must be drawn from the plains, as the Dhoon affords nothing[3].

The magistrate was not over-awed by this bombast, but replied politely that Chāndni Pahar was outside his jurisdiction, defended his own staff, and promised all possible assistance as soon as the great man should enter Sahāranpur territory.

> The tuhsildar and most of the officers of his establishment are actively engaged in the revenue survey operations [220]...which will scarcely admit of visits of ceremony. ... Chundee being, moreover, in the Kumaon jurisdiction, it is very possible that...the native officers of my district...may not have it in their power to supply your camp. ...
>
> There are certainly a large number of baneeahs' shops at...Hardwar, but I much question if...any one would...cross the river [Ganges]...during fair time, when he might reasonably expect to net a much higher profit by remaining at home. ... It would be contrary to law... to compel him to provide you with supplies when encamped in another jurisdiction[4].

As a general rule surveyors had every support from local officials, even when working through the kingdom of Oudh, but there were unavoidable delays in planting survey flags on village towers, or clearing trees [158–60]. On the other hand, Everest himself was constantly embroiled through impatience and insistence of his own importance. Delays and difficulties with Gwalior State during season 1836–7 were greatly magnified by his own intolerance and obstinacy. Before starting out he wrote politely enough to the Resident, John Sutherland[5], giving his programme of marches, and asking for all assistance from the State authorities,

> as my parties will be large and scattered. ... The public property under my charge is of great value, and if injured or lost cannot be replaced. ... A party of 50 horsemen of the Maharaja's contingent may be ordered to meet me on my arrival within the Gwalior territories, furnished with such purwanas as you may deem fitting[6] [40].

The Resident promised to help, but advised that the survey parties should take

> such labourers as would place you beyond the necessity of relying on the people of the country, or at all events...have the means of paying...at such rates as may induce them to enter your employment without compulsion. ... There will be no danger to the public property in any part of Gwalior Territory and I shall request the Durbar to attach...a party of Horse sufficient for your protection. The Gwalior Contingent cavalry has been reduced to one regiment, which will be reformed...in the course of the ensuing cold season[7].

Everest complained that this was not very helpful, and the Resident explained to the Lieutenant Governor why he could not promise all that had been asked for ;

> Only two officers have...been employed on survey duty within the Gwalior Territory since I have been Resident, Lieut. Ommanney and Lieut. Jones [39, 63], and the conduct of those gentlemen...was of such a...conciliatory description as to render unnecessary any interference on my part, whilst on the termination of their duties...I received...intimation of their perfect satisfaction with the manner in which they had been...treated. ...
>
> The only questions...were on the...cutting down trees, and the construction of a bastion on the gate of the fort of Bhind. ... There was at the Durbar...so strong an aversion to interfere ...that...I...left the surveyors to make their own terms, ... and I was happy afterwards to hear from Lieut. Ommanney that he had succeeded in effecting his object. ...

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[1] DDn. 289 (4), 8–4–34. [2] *ātā*, coarse flour. [3] ib. (6–8), 10–4–34. [4] DDn. 288 (124–7), 12–4–34. [5] (1792–1848), Bo Cav. ; AGG. Rājputāna, 1840–8. [6] DDn. 346 (163–4), 9–9–36. [7] DDn. 345 (193), 16–9–36.

> There are two points on which I do not feel that I can coincide with Major Everest—applying to the Durbar to force people to take employment on...the survey—... throwing open the gates of the fortresses...at his bidding. ... I shall have the honour of...assuring that gentlemen that the information...of the disturbed condition of the Gwalior territory is erroneous, and that he may banish all apprehension. ... A party of His Highness's troops... has already been appointed to protect the survey[1].

The Resident was at pains to win the Durbar's sympathy for the scientific work of the survey, and was assured that whilst they did not like giving free permission to build survey platforms in fortified places, yet they had no objection to the erection of signal flags. Everest was sent a copy of this correspondence but, when he found no officials to greet him at Dholpur on the Gwalior border, he wrote furiously to the Supreme Government complaining of the Resident's neglect ;

> It is totally impossible for me to proceed...under the course pursued towards me by that functionary. There is no remedy but to wait on the boundary until the obstacles thrown in the way of my progress shall be either removed by him voluntarily, or...by more decided orders from the Supreme Government. ... Forms of courtesy...which are deemed essential at native courts have been entirely violated. ... I am spoken of in his communication with the Muktiar as 'one Major Everest engaged in measuring', and...my assistants...in the some unceremonious style. ... Major Sutherland's own designation of Resident is carefully retained. ...
>
> This is the first instance of rudeness and opposition which I have experienced on the part of a British functionary. ... Last season nothing could surpass the...civility shewn towards me and all my subordinates in...the States of Tijara, Alwar, Bhartpur, Karoli, Dholpur ; there was no delay in any instance. ... It was not possible to exceed the ready goodwill and cheerful co-operation of Lieutenant Colonel Alves [II, 370 ; IV, 272][2].

He wrote at the same time an indignant letter to Sutherland protesting against the omission of his official designation as Surveyor General in the persian letter, and at the failure to promise daily supplies or adequate armed guards for all his detached parties. The Resident replied that he had thought

> you would be accompanied by bazars sufficient to supply your daily food. ... You did not adhere to your original plan which would have brought you to Gwalior instead of Dholpur on the 2nd. ... You would have found plenty of supplies at Hingwana. ...
>
> I am sorry that I should have omitted in my letter to Scindiah's Minister your official designation of Surveyor General and Superintendent of the Trigonometrical Survey. But the last two are terms not easily rendered into Persian, and the English words would have conveyed no meaning to the people of Gwalior. ... Neither...was there any intention of treating you... 'with indignity or want of ceremony'. ...
>
> It had been...already announced to you that an Agent and a party of Horse would attend yourself and each of your detached parties. ... I shall be very much surprised if you do not meet with every attention and civility...within His Highness's dominions. This will necessarily, however, depend in no small degree on the temper and judgement by which your own communications with the local authorities are regulated. ...
>
> In conclusion, ... there is a dictatorial tone pervading your letter...which I cannot think that the Surveyor General of India is justified in using towards the Resident at Gwalior[3].

Everest remained obstinately at Dholpur for two weeks refusing to cross into Gwalior until a State official should appear with ample provisions. Finding that Sutherland was so little interested as to proceed on tour, he put himself further into the wrong by writing direct to the Durbar. At length "a party...arrived at Dholpur to meet and escort me", and on arrival at Gwalior he was immediately called on by the *peshkar* who, writes Everest, gave him the warmest welcome ;

> 'The Maharaja expects you will halt 4 days here in order that he may do you honour and receive you properly. This evening...the Mahma Sahib will wait on you, and tomorrow you will go...to Durbar, and then there will be fireworks and nautches and elephant fights, and everything to delight and amuse you'. But I stopped him...by saying 'Ah, Tatia Sahib, there you must pardon me. Remember I have lost 13 fine days already, so that now I have not a day to spare. ... I must march tomorrow'[4].

Whilst Government called the attention of the political authorities to the delay that had occurred, and asked them to do all they could in future to assist the survey, they left Everest himself in no doubt as to their stern disapproval

[1] DDn. 345 (210-3), 5-10-36. [2] DDn. 346 (202-5), 5-11-36. [3] DDn. 345 (252-60), 7-11-36.

[4] SG. to Mil. Dept. 20-11-36 ; DDn. 286 (406-8).

> You have expected from the Gwalior Durbar an observance due only to a public officer charged with diplomatic functions. ... Had you at once passed the Chambul, the anticipated difficulties would either not have been encountered, or would have yielded to your own energy and exertions. ... The Governor General in Council, while he regrets that more exertion was not made on your part, ... directs me to express his hope that no further delay will occur in the prosecution of your important and expensive work, and that precious time will not be again wasted in reference to distant authorities. Finally, His Lordship in Council directs me to express his disapprobation at the tone of your letter of the 5th instant to Major Sutherland, and of your procedure in directly addressing the Gwalior Durbar[1].

Everest was in no way abashed, and continued in all his reports of the incident to blame the Resident for the wasted weeks. The following season he had once more to arrange for a journey through Gwalior on his way to measure the base-line at Sironj. He writes to Government that he had written to

> the Resident, ... and requested that the peshwai from the Gwalior Government may be in readiness to meet me at the boundary...in time to prevent any delay. ... I solicit...His Lordship in Council to support this application so decisively as to leave no room for mistake. ...
>
> Theft is so notoriously carried on in the vicinity of Gwalior, the police of that country is so inefficient, the state of society so disorganized, and property is so insecure, that it would be the height of imprudence in me to venture articles of so much worth within the limits of that State without the fullest protection [152]. ... I have never found...Major Sutherland to attach due weight to matters of this sort. On the contrary, both that officer and Sir C. T. Metcalfe [1 n.1] appear...to think it would have been perfectly safe...for me to proceed into the Gwalior territory without any peshwai or escort. ... If my camp were to be detained at Dholpur as last year, my arrangements would be very seriously interfered with[2].

Sutherland warned Everest that the supplies would be desperately short

> on account of the almost complete failure of the rains. From the Jumna and the Chambul to...the south, and from the latter river to the Dhuttia frontier on the east, ... six inches of rain has not fallen throughout the season. ... The Dussera is past; no rain has fallen; nor is there any appearance of any, and none of the rubbee crops[3] are sown, nor can they be unless rain falls, whilst the wells are already half-empty. ... Many of the poorer inhabitants have left the country, others are preparing to follow. Labour of every kind has...risen enormously in price. ... Wheat in the Residency bazar is now 7¼ seers, and gram 8¼, per rupee.
>
> I shall be at the Residency, and happy to see you and your party there, early in the month.... But how you are to subsist I know not. ... You will require to bring almost everything with you from your own provinces, where too, particularly above Agra, they are almost as badly off as we are. ... Starvation of man and beast, and the latter more than the former, is more to be feared in this famine than the badness of the roads[4].

This time all appears to have gone smoothly in spite of the scarcity, and we hear of no trouble with Gwalior. There was, however, trouble at Kaliāna on the way down and—when starting the reconstruction of the astronomical circles, putting up workshops, and finishing off the observatory [83, 98, 128]—Everest expected the local officers to act as "universal aunts". He writes to the Commissioner that

> during the time of Mr. Franco[5], the native authorities at Muzafarnagar were so civil...that I never once had occasion to trouble Mr. Hutchinson. ... Things are, however, mightily altered for the worse. The native authorities...send impertinent answers...that they cannot comply with this or that call unless expressly ordered by the Collector[6].
>
> It is now upwards of 6 days ago that I sent an application...[for] a few donkies to bring bricks from Dehra for constructing a workshop and other buildings, ... and to this hour they have not been sent, and the daily answer has been 'they shall be sent to-morrow'. ...
>
> What Mr. Crawford[7] desires I do not know. ... I shall be unable to get a handful of nails, or a few hundred bricks, without his sanction, obtained through a long and tiresome correspondence. ... In the time of Mr. Hutchinson it was expressly ordered that at every place where I had business, the tahsildar or peshkar, and the thanadar, should wait on me...to... know my wants, and comply with them[8].

Three days later he wrote again saying that he was starting for the south, and asking that every help should be afforded to Barrow;

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[1] DDn. 341 (74-5), 28-11-36. [2] DDn. 342 (47-8), 31-8-37. [3] of winter season. [4] DDn. 345 (494-5 ; 503-4) ; 13 & 15-10-37. [5] Geo. Fleming Franco (1798-1870) ; BCS. 1817 Comnr. Meerut from April 1840. [6] John Ross Hutchinson (1792-1838) ; BCS. 1808. [7] James Henry Crawford (b. 1811) ; BCS. 1828. [8] DDn. 346 (401-2), 15-10-37.

> Matters are getting worse and worse. My workshop is without an atom of charcoal. I can get no assistance whatever from the inhabitants. My workmen have no place to shelter them from the...wind, because the authorities will lend me no aid to transport bricks. ... It is necessary to remodel the astronomical 3-feet circles, to erect a workshop and other buildings, ... and if this be not accomplished by 1st October next, another season will be lost[1].

The Commissioner at first ignored these tiresome complaints, but, receiving yet another couched in language he could hardly overlook, he passed it to Government, and Everest again drew a stern rebuke[2].

After completing the remeasurement of the Sironj base-line Everest sent Waugh southwards to re-observe the earlier triangulation through the Vindhya Hills. He asked that through the Nizām's territories Waugh should be accompanied by "a native gentleman of the Court", as had proved successful in Gwalior;

> There is...no department in India...where violence, injustice, and illtreatment of all sorts towards the inhabitant are more thoroughly discountenanced than in mine. ... All I ask is that my subordinates may not be exposed to die from hunger whilst in the execution of their duty in the wilderness, or be left to perish miserably by the roadside, two evils to which they are perpetually liable, and of which it is difficult to convey an adequate notion to gentlemen who sit quietly at home, surrounded by their comforts, and enthralled by their dignity[3].

It is a relief to record that Everest's last journey through Gwalior went happily with but one complaint. After crossing the Chambal to Dholpur for the last time he writes to the Resident—no longer Sutherland—appreciating the services of the *pandit* and the escort attached to his camp, but recording

> the uncivil and highly improper demeanour of the Kamashdar at Dhanela, who positively refused to furnish my camp with the necessary supplies on the morning of its arrival. ... With this solitary exception...the greatest kindness and attention have been experienced by me from all parties in the Gwalior territory in my late march[4].

In later correspondence with the Commissioner of Morādābād, he claims that parties of the Great Trigonometrical Survey should be granted special assistance, and not left to find their way about the country as if they were mere members of the travelling public. He protests that

> the impression seems to pervade the whole of your letter...that the circumstances of persons employed on the G.T. Survey...are precisely analagous to those of travellers, but...the latter proceed along high roads and can encamp near bazars...where supplies can be procured. The former cannot, for the...stations at which they are sometimes...located for 10 or 15 days together are...oft-times in the midst of wildernesses...far beyond reach of any human habitation. ... Travellers can proceed when they choose, and halt when they please, but persons...in the G.T. Survey cannot, for they are dependent on the state of the atmosphere. ...
>
> I earnestly hope that...you...overrule the objections made, ... and...afford to Mr. Lane the assistance necessary. ... A refusal...will render imperative...a reference to Government, which can only terminate in one of two ways. Either that a stop will be put to trigonometrical operations altogether, or the aid required will be insisted on[5].

The claim that surveyors should be given special assistance by local authorities under orders of the central Government is still a matter of interest to surveyors of the 20th century, though difficulties of transport and supply are far less acute than in Everest's days. It is still a standing order that ample notice shall be given to district officers of the movements of survey officers and parties. In difficult and sparsely populated areas—in areas liable to political disturbance—surveyors must still keep in close and friendly touch with local authorities and learn from them what local help they can expect, and to what extent they must be fully self-supporting. Compulsion is out of question. Everest's experiences show how quickly misunderstandings degenerate to unseemly wrangling, which leads nowhere.

CLEARING OF TREES

So long as the survey proceeded in the forests and hills of central and southern India, little difficulty was found in the clearing of trees between one station and another. Trees on a lonely hill top had no more value than grass, and all that was required was the labour and the tools for their felling. In the rich and populous plains of Bengal and the upper provinces the matter was different. Trees here had private owners, jealous of their value for fruit, timber, or sentiment, but they were particularly tiresome to the surveyor from their wilful clustering along the very lines where clear view was sought. James Western appealed for the Surveyor General's support [59] ;

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[1] DDn. 346 (407-10), 18-10-37. [2] DDn. 342 (86-96), 14-1-38; paras 31-5. [3] ib. to Mil Dept., (100-11), 26-1-38. [4] DDn. 406 (18-9), 2-2-41. [5] ib. (150-2), 17-9-41.

> On the left bank of the Ganges, there being no hills, I find it necessary to cut down trees which obstruct the view. The Zemindars refuse to sell their trees under the exorbitant sums of fifty rupees, and bamboos one rupee each (not a bush, but a single bamboo). ... It will be cheaper to build towers to see over the trees, but...again the zamindars refuse to allow me to do so. They also prevent my hiring coolies. They say plainly enough, 'Who are you ? Where is your purwana ? We want the Judge Sahib's hookam[1], not yours'.
>
> I called on the magistrate. ... He was very civil...and desired me to write an official letter, which I did, ... but to this day [I] have received no answer, purwana, or anything else[2].

When he first started working his Great Arc across the Jumna-Ganges plain to the north of Delhi, Everest thought he was master of the situation ;

> Fruit-trees are paid for, but not pipal trees nor date trees, nor anything not yielding produce. I have generally contented myself with cutting the upper branches, paid one or two rupees, and left the wood to the proprietors. But for pipal trees...no person has a right to make any demand, nor for nim or babul, unless you remove the wood [26][3].

This was all right when trees were few, but the problem generally was a very formidable one. The *doāb* [III, 522] is

> very highly peopled and cultivated, and though there are no forests, yet the groves of the mango, mulberry, jaman, and other trees, intermixed with lofty pipals, are abundant and extensive, all either yielding an annual income to their proprietors, or endeared to them as fancy plants, destined to perpetuate the name of him who reared them. ...
>
> The inhabitants are congregated in villages...which vary...according to the wealth...of the owners, from the veriest hovel...of straw to the costly four-storied edifice of masonry. ...
>
> The villages...lie so thickly scattered...that it is difficult to trace a line in any direction so as to pass free of all habitations, and quite impossible to calculate on seeing...between the trees, which, ... generally speaking, ... form to all appearance a continued belt of lofty foliage at the distance of 5 or 6 miles from...the observer, and if a...space is anywhere found, it as often as not leads to low marshy land, or some other spot totally ineligible as a station[4].

Drastic clearing was often required, and Everest reports to the Collector that

> great destruction has unavoidably taken place...in clearing the rays towards Sheopuri and Saini ; ... thickly planted groves of high mango trees obstructed the view. If there had been but a few trees I would have settled the value on the spot, and paid the price, ... but I have no leisure to make the requisite enquiries, ... and I might do injustice...by undervaluing the... property felled, or squander the money of the State...by overestimating it.
>
> I have directed the tahsildar...to estimate the value, but I am afraid he will be too slow. ... Timber is scarce and fuel dear in this part of the country—mango trees are very abundant—and mangos very cheap. The bazar price of the ordinary sort...is...4 pice per hundred, and some of the trees felled will produce in plentiful years 2,000 ; in scarce years none at all, whilst others were in so decayed a state and so miserably poor to be hardly any value at all. ...
>
> I had to fell some trees near Dateri, and the price for five trees of 30 and 40 years growth was 5 rupees each, with which the owners were well contented. Some of the trees...are of first-rate kind. ... In one or two the timber is so good that the proprietors talk of its being fit for sugar mills, in which case...a considerable reduction would be reasonably expected[5].

An official account was prepared, which Everest thought exorbitant ;

> As no...timber...has been removed, the value of such trees as produce no fruit is in no wise diminished, and in a country where firewood and timber both fetch a high price, the felling of such trees cost-free is in every way a boon to the owners. Under this head...sissoo, nim, kikar, pipul, bur, and kachnar trees ought to be classed. ...
>
> Mango, jamun, and tut trees...must of course be paid for, ... but as the estimate...is highly exorbitant, ... I shall...decline paying any sum until it receives the sanction of your opinion[6].

[1] *hukm* = order.

[2] DDn. 330 (43–5), 1–4–33.

[3] DDn. 321 (133–5), 9–2–34.

[4] Narr. 1833–4 (2–4).

[5] DDn. 287 (341–3), 29–3–34.

[6] DDn. 265 (27–8), 25–4–34. Sissoo or Shisham, *dalbergia sissoo*—Mango, *mangifera indica*—*jaman*, or *eugenia jambolana*—*pipal*, or *ficus religiosa*—*nim*, or *azadirachta indica*—banyan, or *barh*, or *ficus bengalaensis*—mulberry, *tut*, or *morus alba*—*babul*, or *kikar*, or *acacia arabica*—*dhak*, or flame of the forest, *butea frondosa*—*Kachnar*, or *bauhinia variegata*.

Narsin [village]		*Birla*	
11 Mango trees ...	Rs. 55	1 Sissoo ...	Rs. 7
2 Jaman ..	9	1 ,, ..	5
2 Pipal ...	3	1 ,, .	4
1 Nim ...	4	*Manla*	
Kutubpur		1 Tut ...	2
2 Pipal ...	8	*Daghat*	
1 Nim ...	4	1 Pipal ...	15
1 Burr ..	4	1 Kikar ...	2
1 Pipal ..	5	*Toghalpur*	
1 Kachnar ...	2	2 Dak [158 n.o]	2

This tale of tree cutting is nothing compared with the clearance of buildings for the final observations two years later [79, 105–6] ;

> The ray Dateri to Bulandshehor, 26·2 miles, has been the most embarrassing...of the whole season. In the approximate work I had hoped that the height of the mound ...would have enabled me to dispense with any other artificial elevation than...a disused mosque with a vaulted roof standing on the highest part of this mound. In the approximate work I left this ray to be observed by Captain Wilcox, but...he did not reach Bulandshehor until the favourable season for observing was at an end.
>
> It was therefore left untouched until my arrival on the 15th January 1836. ... The intervening trees...having been felled, ... it was expected...that either the heliotrope or the lamp at Bulandsheher would be seen, but...not a glimpse of either reached me at Dateri. The ray passed over...Ramnagar...and the large town of Bhatona, the latter with lofty houses through which it became absolutely necessary to cut a gap 30 feet wide.
>
> The houses which stood in the way were selected by...Mr. W. Rossenrode with extreme care, so that no needless injury might be inflicted, and...duly valued by a panchait...of several tahsildars, peshkars, kanungoes, and others, ... so that the proprietors, on consideration of... ready money, were...satisfied. The list of dwellings destroyed, however, is disastrous, and I hope it will never again fall to my lot to have so disagreeable a task to discharge. ...
>
> 5 huts, thatched, in Ramnagar, crushed by the fall of trees. 37 flat-roofed houses, 52 huts...of mud, rased to the ground in the town of Bhatona. 12 huts, thatched, with mud walls, ... Daherpur.
>
> How Mr. Rossenrode contrived to effect this severe operation, and reconcile all parties, ... surprizes me. The town of Bhatona is inhabited by Jaths, who have the character of being a very turbulent...race. ... Amongst these he ventured unarmed—and without a single weapon of defence or any show of force—and, though the weather was unusually cold, and hardly a night passed without a severe hoar-frost, yet he had influence enough to persuade the owners to relinquish the houses which furnished them a comfortable shelter. ...
>
> After the clearance...the blue lights burned at Bulandsheher were at last seen[1].

In choosing between the humble villager and his triangulation points Everest had no hesitation ; the work should not suffer ;

> Though I would not scruple to stick to a point possessing all the requisites, yet I had rather avoid molesting the poor village clods, because I do not like being molested myself, and our religion teaches us to do as we would be done by. But, if it is necessary to abide by the present point on account of its peculiar eligibility, ... remunerate the poor people for the property you injure, and leave no cause for complaint[2].

On the Amua series Renny reported frequent opposition.

> and, though I feel the greatest repugnance in felling the trees, ... yet in a country so studded with topes my rays must...pass through some.
>
> In Bengal the parties...found it necessary to have a specific clause...in their purwanahs respecting the felling of trees and the occupation of temples or old buildings. On an attempt... to cut a single tree, the whole village would turn out and listen to no arrangement for remuneration, but threaten an immediate appeal to the Collector, unless convinced by the purwanah. The price was then fixed, and the trees cut down. ... The permanent settlement existing [I, 140–1], the full value was paid for the trees. A periodical settlement obtaining here, it will perhaps be sufficient to remunerate...for a year's loss[3]. ...

He asked for official assistance, pointing out that the villagers

> will remain days undecided on the advantages or disadvantages of selling their trees, and my

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[1] Report 1836. Description of stations: sv. Dateri. [2] DDn. 321 (325–8), 31–5–35. [3] to AGG. Bundelkhand, DDn. 322 (73–5), April 1834.

> time...will be frittered away in making bargains, when the tessildars, ... from their superior knowledge of...the market rates, ... would determine the...compensation in a few minutes. ...
>
> The practice which would be most...economical...is that which is pursued in England and all other countries, viz., the work is carried on vigorously by the officer in charge...and the damages estimated by the competent local authorities[1].

To Government's first orders that no tree was to be cut down without the owner's consent and payment of compensation, Everest pointed out that the

> answer given may be easily divined; 'Go about your business; you shall not cut down our trees on any terms', ... accompanied by language abusive of our nation and faith. ...
>
> It is manifestly...vain to think of, ... unless the Government...put the State to the cost of raising edifices of masonry sufficiently high to overtop such trees. ... Towers...from 70 to 100 feet may...effect this object, and their cost will not perhaps exceed 7,000 or 8,000 Rs. each. ... I beg not to be understood as recommending this measure, for I have a great dislike to raising...my instrument one foot more...than is absolutely necessary.
>
> It is in my opinion...necessary that the officer at the head of the party, after determining precisely what trees obstruct the ray, be empowered...to fell each and all; that either the tahsildar or his peshkar be in attendance, duly authorized to enquire who the owner is of each individual tree so felled; that a statement of the amount justly due to each proprietor, bearing the signature of the Collector, be sent to the officer as soon...as circumstances admit; and that the officer pay the sum to the Collector, and charge it in his contingent account[2].

Government refused to sanction such "removal of trees without the prior consent of the owners", and directed that the *tahsildar* or *peshkar* should be present when difficulty was anticipated and that, where the owner was obdurate, formal application should be made to Government[3], a procedure that Renny followed with reasonable success when working through Oudh [67].

Murphy found welcome co-operation at Sahāranpur when clearing the ray from the Judge's house, Belleville [III, 38, 175], to Everest's station on Banog;

> Judge Boulderson kindly shewed me Budraj, whence I recognized Banog, but found it completely hidden from the Belville pillar by the trees in front of his house, and as these could only be partially cut or trimmed and not disfigured, it became necessary...to ascertain the exact ray prior to cutting anything. This being found, Judge Boulderson did not hesitate in cutting and trimming as many of his trees as were indispensably necessary, and when these were cut, others on the opposite side of the nuddee were found to interfere[4].

Everest urged careful reconnaissance before starting to clear;

> A deviation of 10 to 15 feet to the right or left...is of no great matter, whereas it is a serious source of expence, ... and a heavy infliction...on the owners, when a gap is cut through a well-built decent town, and therefore not one inch should be cut unnecessarily.
>
> The distress to the owners...is a very proper subject of consideration. ... But, when it is a necessary infliction, there is no use in wasting time repining. ... If a patient have an operation to be performed on him, a man of iron nerve is the best for his purpose. The practitioner whose nerves shake for sympathy with his patient may be more amiable, but he is the most humane who cuts with an unflinching hand, and it is just the same with the clearing of rays[5].

INHABITANTS

As a general rule the people of the country, and more especially the cultivators and villagers, were friendly enough, and quite ready to provide guides, labourers, and supplies, so long as these were properly paid for. There was naturally considerable opposition to the ruthless clearing of trees, though here again prompt payment would generally bring cheerful consent [63, 79].

Obviously surveyors required ample supplies of ready cash, and authority to charge all such payments to their contingent bills. Labour was cheap if not always abundant. Boileau asks the treasury on one occasion for "new pice to the value of Company's rupees two hundred", and on another—"there being much trouble in procuring copper coin in camp"—asks that his draft should be met "entirely in pice, particularly of the small thick kind called ghereedar paisa"[6].

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[1] to SG., DDn. 382 (93–5), 25-2-35. [2] DDn. 286 (188–92), 2-3-35. [3] from Mil. Dept. 6-4-35; DDn. 374 (132–3). [4] DDn. 333 (107–10), May 1835. [5] DDn. 374 (179–80), 8-3-36. [6] DDn. 370 (12, 35), 10-11-36; 3-1-38.

Though in the Company's own districts the people were as a rule quick to accept the magistrate's *parwāna* as full authority, occasional difficulty was experienced in independent States, with local officials who were jealous of their own importance. In unsettled areas such as Bundelkhand the minor chieftains recognized hardly any authority, and Macdonald found the country in a very disturbed state.

> Massacres and robberies are perpetrated wholesale. At one village...24 men were killed and wounded in one affair, while on the other side the garrison of Chanderee was in open mutiny [62–3]. The Jhansee State is also infested by bands of Boondela cossacks, but we keep on good terms with all parties, and a few kind expressions never failed to conciliate these lawless robbers, for the most respectable thakoors and zumeendars join the plundering excursions. Our name, however, became a passport of safety and, excepting a little hostility on first taking up a station, we met with no annoyance[1].

His platforms and markstones were interfered with [III, 415 ; IV, 266] ;

> After having passed the rains at Saugor, I have now taken the field, and...find that, influenced by superstition, the inhabitants of the Jhansee and Chunderee States have thrown down the platforms which we had built. ... The triangulation...must consequently be done over again at a heavy expence. ... The first-mentioned rajah is, I believe, favourably inclined, but his thakoors are refractory. The latter rajah is, I suspect, inimical, and I...understand that the Dhundkooa platform was pulled down by his authority, the...want of rain (it is said) having been attributed to the evil influence of our operations[2].

This superstitious distrust is described by Sir William Sleeman, who had unrivalled knowledge of the India of this period ;

> In 1832 the people began to search for other causes [of poor crops]. The frequent measurements of the land...to equalize the assessments were thought of [6–9]. Even the operations of the Trigonometrical Survey—which were then making a great noise in Central India, where their fires were seen every night burning upon the peaks of the highest ranges—were supposed to have had some share in exasperating the Deity ; and the services of the most holy Brahmans were put in requisition to exorcise the peaks from which the engineers had taken their angles the moment their instruments were removed.
>
> In many places, to the great annoyance and consternation of the engineers, the landmarks... were...removed, ... and they were obliged to do their work over again. The priests encouraged the...peasantry to believe that men who required to do their work by the aid of fires in the dead of night upon high places, ... work which no one but themselves seemed to be able to comprehend, must hold communion with supernatural beings, which they thought might be displeasing to the Deity [86][3].

Three years later Everest complained of persistent destruction of markstones along the Great Arc, which seemed to be particularly wanton in Gwalior territory. He even suggested that this was encouraged by State officials, though the Resident assured him that the Durbar held the survey in equal respect with "the astronomical operations of Maharajah Jai Singh" [I : 149–50][4].

Macdonald had many other adventures to record ;

> On my march to Burwa Sagur[5], I pursued the road to Jhansi. ... Khelar was plundered the day before Mr. Scully reached the village, and he states that the villagers were stripped, even to their last piece of clothing, by the relentless Bhoomyats. From Khelar I crossed to the ancient, but now partially delapidated, town of Oorcha[6], at the gate of which I was detained for some time by the over-scrupulous guard, who at length opened the massive portal on my inducting myself through the wicket, and quietly telling them that I must make myself comfortable there for the night if they would not pass my horse and camels.
>
> After entering this gate I had nearly a mile of houseless space to cross...before I reached the part now habited, and this I found a busy and well-peopled place, with many substantially built bazars and streets, and numerous temples. After some demur at the chubootra[7], and a reference to the fort, I was accommodated with a guide to conduct me across the seven channels of the Betwa, which flows 1 cos [III, pl. 15 n.] from Oorcha and two from Burwa Sagur, through very rocky channels rather difficult for cattle to cross.
>
> [He describes] a cave which we visited near the Undhiyaree station. It is low and narrow, and we had not sufficient...love of enterprize...to penetrate beyond a few yards. Tradition

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[1] DDn. 372 (55–8), 6–7–33. [2] ib. (81–2), 21–10–33. [3] Sleeman (201). [4] DDn. 376 (22–4), 16–1–36; 345 (240–3), 28–10–36; 341 (231–2), 14–12–37; 342 (178–84), 29–5–38; 347 (167–9), 18–6–38. [5] 12 m. SE. of Jhānsi. [6] Orchha, 8 m. SE. of Jhānsi. [7] platform, being village meeting place.

> relates that when the village of Sirsood was attacked, the inhabitants sought refuge in this cave, to which they were pursued...and smothered by fires lighted at the mouth. ...
>
> Had a visit from Bahadurjee. ... His nephew...came to announce his coming, and to request that I would rise to receive him, as his Khitab of Bahadooree entitled him to that distinction, even from the Raja. I humoured them accordingly, and the Bahadoorjee, a stout old man, came in. ... Bahadoorjee formed one of the garrison of Chunderee when first attacked by the Marhattas, and he says they never would have taken it, but by starving the garrison out.
>
> The thakoors and Boondela Rajpoots are a well-made, active, race, and usually present the bold bearing of men accustomed to carry and use arms. Young thakoors of 10 to 12 years of age always carry a sword or spear[1].
>
> Our progress...has until lately been uninterrupted. ... The Raja's authority is no longer respected, either by the disaffected thakoors and Boondelas...or by the well-disposed, against whom the depredations of the former are directed. The one party...have until lately respected the Trigonometrical badge, and permitted our people to pass unmolested, where robbery, if not murder, awaited every common traveller. ... The other, trusting...to the English flag on the walls of Jhansi, have been no less friendly, but the apprehensions of the former and the hopes of the latter seem suddenly to have evaporated.
>
> Ten days ago the village of Gwalee at one of our Trigonometrical stations was...plundered. Some of our beldars' tools...were carried away, and one of our flagmen who attempted to remonstrate was fired upon. ... Five of our flagmen have been robbed of their knapsacks, clothes, and cooking-pots near Burwa Sagor, and on the 26th instant several matchlock shots were fired at myself and three servants who were with me at 8 p.m. on the 24th in passing the village of Simurra near Jhansi, having been benighted on a long march. That village had been burnt the night before, and the people who attacked me called out before they fired that they did not care for the Saheb-log who permitted their country to be plundered[2].

He had yet another outrage to report ;

> Two flagmen...were waylaid and plundered of clothes and money on the 10th instant, on the road between Khylar and Jhansee. ... About noon, ... as they were returning from the Gwalee trigonometrical station where they had been burning lights for observation [62], they were stopped by seven horsemen who dragged them off the road to a hill on which a Boondela thakoor and his followers were on the look-out for prey.
>
> On learning that they were Company's khulassees, the leader...said they must be put to death. He relented, however, on their prostrating themselves before him with grass in their mouths, thus appealing to his Hindoo feelings of reverence for the innocent cow, but they were deprived (according to their own account) of Rs. 19 in cash, together with their clothes and cooking-pots. Their knapsacks, caps, and...jackets only, were returned to them as useless ; but a trigonometrical survey breastplate [badge of office] was retained[3].

He turns from assaults and outrages to the peaceful lives of holy men ;

> Near Dholpur is a hill rendered sacred by the shrine of a Mahammedan saint, and the holy cave of a Hindoo devotee. ... The devotee who now occupies the holy cave subsists on wild plants and frequently shuts himself up in the cave for days at a time, during which he enjoys a Purseram-like nap. He is a poor, unhappy looking being, who refuses the charity of mortals.
>
> The name of the saint whose durgah appears so conspicuous on the top of the hill was Shah Shurf Oobdel. This descendant of the prophet accompanied the famous Moyen-ood-deen Chishtee from the Holy Land in his journey into Hindoostan. The Chishtee Khwaja having sat down at Ajmer, he sent out his disciple Oobdal with injunctions to proceed in this direction as far as his camel could carry him. For some days and nights did the holy man pursue his journey, until the camel fell down at Dholpur overcome by fatigue. ...
>
> The Syed, ... having removed some objections...urged by...the occupant of the cave to the violation of Hindoo sanctity, ... ultimately conciliated the devotee, ... and took up his position upon the hill. Both these holy places are now visited by pilgrims of the Hindoo religion, although the uncompromising Musulmans confine their pilgrimages to the shrine of their saint. ...
>
> The neighbourhood is infested with serpents 18 feet long, and the present Rana of Dholpoor, having been warned by a gypsey fortune-teller that he would die by the bite of one of those snakes, immediately removed his residence...to a village 3 or 4 miles distant, where he established his cantonment[4].

Joseph Olliver had trouble to the south of Delhi, and Everest reports that

> the robberies and murders committed by the desperadoes thereabouts are such as to spread a panic amongst his followers, and render it well-nigh impossible for him to proceed with his

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[1] TS. 9 (16), 9-12-33. [2] DDn. 372 (118½) Jan. 1834. [3] DDn. 373 (47-8), 18-2-34. [4] TS. 9 (37-8), 5-10-34.

> duty. Some people whom he lately detached to...burn blue lights as signals were...assaulted and robbed, and one of them had his arm broken by a cudgel. ... The alarm has become very general and people will not go on detached duty. Mr. Olliver has...only a guard of one naib and 4 sepoys from Muttra, and...[I] solicit that...you will be pleased to relieve that party by 1 havildar, 1 naib and 12 sepoys[1].

An objection frequently raised against the occupation of high buildings as posts of observation was that women's quarters might be overlooked and their privacy infringed [152], and though these scruples had perforce to be respected Everest could not resist mocking at the request of a wealthy householder that the surveyor should withdraw to a less convenient situation, where he might build a tower to any height he liked. The cost of the move would be paid for ;

> The zamindar must have money in superfluity to be willing to incur so vast a charge for an object so insignificant as that of removing 10 or 20 paces...an edifice which, since it must surpass all circumjacent dwellings in height, would equally command a view of his zenana for people disposed to be impertinent and curious at the distance of ¼ of a mile.
>
> But...the persons of the Great Trigonometrical Survey are of too good taste to concern themselves with...Zalim Singh's zenana, and...he does not do them justice. ... Persuaded... that our telescopes which invert have magic powers, and are able to turn women upside down (an indecent posture no doubt and very shocking to contemplate), it is natural enough that they should assign to us the propensity of sitting all day long, spying through the stone walls at those whom they deem so enchanting.
>
> But the Great Trigonometrical Survey is a department of hard work, and not of idleness, ... and men who sit up all night and all day, with barely time for sleep or meals, have rarely leisure for such trifling as Zalim Singh anticipates, even if their taste were so ill regulated, and their lot so forlorn, as to become a prey to such...speculative amusement[2].

He was, however, far from regarding all Indian gentlemen of position with disfavour, and asks the Political officer to convey to the

> tahsildar of Aring, Imbad Hussain Khan, your satisfaction at the great kindness, civility, and attention, which I and all my people have experienced at his hands. He is a native gentleman of education and urbanity, such as I have rarely had the gratification to meet[3].

MUSSOORIE[4]

Before leaving Calcutta at the end of 1832, Everest asked leave to move part of his office up country "to establish themselves at Mussoorie, where I shall hire an office and fix them until such time as the two northern sections of the Great Arc are brought to a satisfactory termination". He was authorized "to make...the necessary arrangements, ... reporting the same for the confirmation of the Government"[5].

Despatching the greater part of his field office by river under the Registrar, Charles Morrison, he himself visited his reconnaissance parties in the field and, following the line of the Great Arc through Gwalior and Delhi, reached Mussoorie early in May [4, 15]. By the 10th he had taken up residence at Hathipaon[6], or the Park, an estate which he had bought "at a very heavy cost" from Colonel Whish[7], who had built the Park House "in the years 1829–30". Hathipaon hill, 7,089 feet above the sea, lies on the main ridge about 3 miles to the west of Mussoorie, within two miles of the high point, Banog. The Park, covering several acres of well-wooded ground, lies between them a few hundred feet lower [III, pl. 3 ; IV, 166 n.6].

After a long journey by boat [170–2], Morrison reached Garhmukhtesar on the 8th May, and marched up via Meerut and Sahāranpur to Dehra Dūn. Everest wrote to him on 14th ;

> I understand you have taken the old brewery[8]. The situation is not so elevated as the general run of houses. ... I shall be happy to use my influence with the Superintendent of the

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[1] DDn. 287 (120), 28–7–33. [2] DDn. 346 (134–5), 379 (259–64), 11 & 26–7–36. [3] DDn. 287 (255–6), 29–12–34. [4] Start of mil. convalescent depot at Landour, Dec. 1827, encouraged Europeans to settle in Mussoorie ; Williams (164) ; Rambler (14). [5] SG.'s 15–12–32, and Govt. reply, BMC. 19–11–32 (100) ; cf. DDn. 286 (116–7), 17–3–34, & SG. to MAG. 19–5–37 ; DDn. 346 (322–3). [6] or Elephant's foot, appearance of crest from the Dūn. [7] Wm. Sampson Whish (1787–1853), Ben. Art., comdg. Art. at Sirhind, 1827–30. [8] NE. of the Park ; started by Henry Bohlé in 1830 ; bought by Mr. Parsons in 1832, and in 1837 by John Mackinnon, Bohlé's son-in-law [166 n.5] ; Bohlé then opened the new "Bohlé's Brewery" nr. *Lyndale* ; Rambler (16–7).

> Dhoon to obtain building ground on this range for such persons as make known their wishes to me. There is some near Budraj, west of, and adjoining the Park premises[1]. The nature of the Park grounds will not admit of my disposing of any part without spoiling the value of the rest. I cannot allow any permanent building to be erected, neither can I give any person any claim on the land of my estate [166].
>
> I will allow such persons as desire it, and cannot otherwise accommodate themselves, to erect temporary buildings on suitable spots within the limits of my premises on the express understanding that they shall quit...at 2 months' notice, and remove such temporary buildings. ... Temporary huts can be erected of straw or boards, but it will be almost too late...to think of masonry, for it will certainly not be dry during the rainy season.
>
> You must...indent in time...for coolies to carry up the luggage...9 miles from Rajpoor to Musuri, and 7 miles from Dera to Rajpur. Rajpur is at the foot of the ridge. Looking from Dera you see the depot of Landour on the right, and the Park on the left of all. The Park goes by the name of Hatipaon; Budraj is still further to the left of Hathi Paon, but there are no houses there yet. In going to the Park you pass through Musuri; but leave Landour quite to the right. NB. Coolie hire to the Park 4 annas—to Mussoorie 3 annas per man[2].

Office was established at the Park with accommodation for the staff. Water was brought up by 8 commissariat mules, and approach roads were cut ;

> The house where I have fixed my office, though the only one...at all adapted...for the purpose, labours under the disadvantage, common to all other houses at Landour and Masuri, of being at a vast distance from water. ... The native establishment can with difficulty be prevailed on to locate themselves in the vicinity, and...if a conflagration were to happen amongst the huts...there would be no putting a stop to it[3].
>
> The course of the bye-road leading to the office is not well selected ; it is very steep, and I am told in rainy weather so slippery as to be impracticable. Even now it is dangerous for clumsy riders, and my office writers and draftsmen not being accomplished horsemen may get disabled in the descents and ascents. One instance of a tumble has occurred already ; luckily it was not attended with more than a few bruises, but it has determined me to trace out a new direction for the bye-road, and to cut it immediately[4].

Everest was still improving the approaches ten years later, declaring that

> it is contrary to the established principles of the Department that the natives...receiving pay as public servants shall remain unemployed [407]. All men...for whom no other suitable employment exists will...be placed...on the construction of such public roads, in or about the hills north of Dehra, as will be designated by the Surveyor General[5].

He was much disappointed when Government ruled that "the permanent fixture of your office at Mussoorie was never contemplated", and refused to allow him to build an observatory and workshop[6] [99]. He pointed out that the Park was conveniently close to Banog, which would be the terminal station of his principal triangulation. He urged the importance of a bracing climate for the restoration of his health after the exertions of the field season, and the necessity of a definite anchorage for his correspondence, professional records, and heavy baggage, at any rate until the Great Arc should be brought to a close ;

> As the unavoidable consequence of my holding the double situation of Surveyor General and Superintendent G.T. Survey, ... when I do visit the former office from prosecuting my field duties with the latter, arrears of business...tie me down to my desk like a slave to the oar, from morning sometimes till midnight. ... For the first 3 months after my arrival at Masuri, ... I have entered into no society, and have led the life of a hermit [II, 422 ; III, 474]. ...
>
> With a constitution shattered...in my profession, I could not have gone through this sort of work with impunity, unless in a climate which admitted of my keeping my health uninjured, and...the spot in which I have fixed my office is peculiarly eligible. ... At the present moment—instead of finding myself, as I was on quitting the low lands in May last, in the most wretched state of debility—I am in a condition to compete with the arduous duties before me[7].

Hoping that Government would relent, he left his office at the Park for the cold weather, and Morrison reports the arrival of stores sent up from Delhi ;

> All the tools are lodged in one of the rooms of the little range which you kindly gave me leave to occupy until my own house should be completed ; the powder is locked up in the

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[1] implying the hill on which Cloud End house was built later ; Bhadrāj, 7320 ft., lies about 6 m. further W. [2] DDn. 287 (21-2), 14-5-33 ; Sketch map shewing Mussoorie houses from Rajpur to Park, lithd. by T. Black, Calcutta ; DDn. Mgte, file 42. [3] a tank dug by Everest still holds water close to Park House. [4] DDn. 286 (1, 22-5), 10 & 25-6-33. [5] DDn. 356, 21-6-43. [6] BMC. 5-9-33 (63, 65). [7] DDn. 286 (72-81), 27-9-33.

> pantry in Park House. No less than 63 coolies and 3 tindals were required to bring the articles from Rajpore, the hire of whom amounted to Rs. 16-11-0.
>
> The perambulator dials have arrived safely, and remain in Meer Mohsin's possession [146]. The cold so benumbs Meer Sahib in common with the other natives that he is unable to do anything. The weather is at present very pleasant; a hard frost; with about 4 inches of snow upon the ground. Thermometer in the office room stands...at noon at about 40°.
>
> I have moved into my own house. It is not quite finished, but is very sunny and comfortable. Myself and family would have been...ill off had your kindness not enabled us to remove from the brewery, ... the first severe snowstorm having brought all three of the brewery chimneys down carrying a part of the wall with them, and leaving great gaps in the roof.
>
> All the people are quite well here, and are now becoming more reconciled to frost and snow. Our bazar is also much better supplied than at the setting in of the winter, the necessities of life being procurable in sufficient quantity, but at a somewhat enhanced price[1].

The staff now at Mussoorie comprised—Morrison, the Registrar—Peyton, computer—Dias and Ross, writers—Scott and Cornelius, draughtsmen—Mohsin Husain and Shaikh Miajān, in the workshop. On 1st February 1834 a firm order was issued forbidding "all civil and military officers to have their offices in the hills"[2], and on the 21st Everest ordered the move down to Dehra. Morrison replied that

> the office clerks, computers, and draftsmen...will proceed to that place as soon as the records and other property have been removed. The Gurka guard now at Masuri [Park House] consists of only 1 naik and 4 sepoys; the havildar and the rest of the party were withdrawn by Col. Young's orders...after your departure. The naik and his 4 men I will leave here, and... will apply...for a guard of the same strength for the offices at Dehra. ...
>
> The roof of Lieut. Boileau's bungalow is in very bad condition; ... it leaks considerably during the occasional showers of rain. ... The principal room...has to be literally baled out after a heavy shower. ... The roof...appears...to require entire renewal.
>
> As the people...will be put to great inconvenience for want of quarters at Dera, there being only one bungalow to let in the station, I request your authority to apply to Mr. Logan for any spare tents...at Saharanpore [139, 166-7][3],

Everest replied that Boileau's bungalow should have a new roof—that the records should be packed in wax-cloth against the rain—and that spare tents should be demanded from Logan. Morrison reported a week later that he

> was up at Park House yesterday (Sunday). The weather was very fine, and everything about the Park looked fresh and beautiful. Contrasting it with Dehra I could not help feeling sorry that the office was removed; ... indeed, in the bitterness of my spirit, I was tempted to shower anything but blessings on the head of the authority of the recent order. I hope, Sir, you at least will not be debarred from residing at Masuri during the hot season. The intention of Government is fulfilled to the letter by the removal of the office and establishment to Dehra. ...
>
> I left the artist and blacksmith at the Park...in the hope that you would have been back to Masuri ere this. The expence attending the removal of...the workshop and forge...was another consideration. ... Meer Mohsin has nearly finished the...two other perambulators [*sup*]. ...
>
> For giving a new roof to the office bungalow I called in several sets of gurramies [thatchers] in order to get an estimate. ... The entire cost will not fall far short of 300 rupees[4].

Government made no objection to Everest and his assistants spending the rains in Mussoorie now that his correspondence office was at Dehra all the year round. The arrangement made on leaving Calcutta had been that the rent saved by giving up the separate building for the computing office might be spent on the field office up country[5] on condition, writes Everest, that

> there should be no increase of expense to the State. Instead of one office therein allowed, I have supplied two offices, one for the Survey General's department at Dehra, and one for the G.T. Survey at Hatipaon, as also six rooms as workshops, without any increase of expense to the State, and at my own risk, ... all which buildings still hang on my hands, as I have been unable to dispose of them at a remunerating price[6].

From time to time he erected various buildings of a temporary nature—in July 1835 De Penning despatched a case of "3 dozen window glasses" by steamer from Calcutta. In 1836, in his usual peremptory way, Everest called on the police at Sahāranpur to send him several saw-men. The magistrate protested;

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[1] DDn. 288 (8-10), 6-1-34. [2] GO GG., 1-2-34. [3] DDn. 288 (75-7), 26-2-34. [4] ib. (101-3), 4-3-34. [5] BMC. 10-12-32 (108). [6] DDn. 452 (50-2), 9-12-43.

> The Cotwaul[1]...has, this morning, handed to me a purwaunah...with your signature upon it, desiring him to despatch forthwith to you at Munsooree four sawyers, who are required there for the "public service". ... It is the duty of the civil authorities to aid, in every legal way, the department over which you preside [151], but I am doubtful whether it is...within your competency to issue orders of this kind...without the intervention of the magistrate. ... There is no regulation extant under which even the civil power can press workmen...for the public service, and...I am unwilling to compel men to proceed at this unhealthy season to the Hills for an indefinite period.
>
> I have called before me some of the best-known sawyers of the town, and they one and all refuse to leave their homes during the rains, unless absolutely forced. ... I would...suggest that...you give authority to the officer in charge of your department here to offer such wage rates as will make it worth their while to engage voluntarily. ... I do not consider myself authorized to enforce the compulsory attendance of the workmen [III, 410–1 ; IV, 154][2].

Everest kept the field workshop and computations under his own supervision at Hathipaon, and brought up Barrow and the astronomical circles for the rains of 1838. The field parties recessed either in the areas of their survey, or at Dehra or Mussoorie, and, writes Everest to Du Vernet in 1842, parties returning from

> field duty and being either at, or in a reasonable distance from, my headquarters cannot be allowed to separate themselves from the general computing establishment. ... It remains optional with you to conduct your computations either at the office at Hatipaon, or Dehra.

Du Vernet preferred to recess at Dehra rather than in Mussoorie, where he would have to "travel daily in all weather a distance of 8 miles in order to attend your office at Hathipaon[3].

In 1839 authority was received for the erection of a temporary observatory, and also for the workshop in which the dividing of the astronomical circles was carried out [134–5] and in 1842, when Everest was taking steps to dispose of the Park and all his private estate, he obtained authority to dismantle and sell all temporary buildings constructed at Government expense ;

> As these buildings stand on private ground, and within the limit of the Park estate, I wish to have a general clearance now made of them, ... so that there may...be no ground to alledge hereafter that any atom of public material is privately appropriated[4].

The Park estate appears to have remained unsold till purchased by Colonel Thatcher on his retirement in 1861. He sold it to Colonel Skinner, who re-sold it almost at once to John Mackinnon some time before 1870[5]. Park House with its line of quarters, and the walls of Logarithm Lodge and the observatory, were still standing in 1956[6] [221 n.3].

DEHRA DŪN[7]

When the Surveyor General's office moved down from Mussoorie, Dehra Dūn was garrisoned by the Sirmoor—later the 2nd Goorkha—Rifles, whose lines and parade ground were situated south of Dehra Dūn Club[8]. The survey office took up ground to the north-east near the Raspana Nāla, where the present Old Survey Road runs. Peyton showed

> Mr. Morrison the ground...for building a bungalow upon, and where grass is already collected. The place will be found in the plan of the base-line ground I sent some time ago, ... being referred by a temple and tree shooting out at the top, about 46½ chains S.W. of Peedee[9].

Everest later records that "when the order...appeared prohibiting the holding of offices in the hills, I erected at my own charge, and at an additional heavy cost, a suitable building in Dehra Dūn". The site was acquired from a zamīndar of Karanpur, about a mile north of Dehra[10].

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[1] head of police. [2] DDn. 345 (134–5), 2–7–36. [3] DDn. 435 (94–5 , 100), 2–6 & 1–7–42. [4] DDn. 431 (198), 25–4–42. [5] John Mackinnon (1806–70), ret. army schoolmaster, of Elgin, Scotland [163 n.8] had opened a private school just E. of the Park, about 1834 ; Rambler (58). [6] Brown's svy. of Landour & Mussoorie, 1842 ; GBO. Lib. A–5 ; MBIO. 185 (11–3). [7] *Memoir of Dehra Dun* by Williams, 1874. [8] built 1903–4. [9] Herbert's base-line, 1818 [III, 37 n.7] marked on MBIO. 15 (36); DDn. 333 (28–9), 28–2–34. [10] DDn. 340 (322–3), 19–5–37 ; DDn. 453 (71–2), 28–7–43.

The senior civil and military officer at Dehra was Lt. Colonel Frederick Young [153 n.3], who had raised the Sirmoor Battalion in 1815, and continued to command it till 1843. He held civil charge from December 1828, being Political Agent Dehra Dūn from June 1833 till November 1842[1]. He was four years senior to Everest, both in age and first commission.

In December 1834 Everest was engaged on the measurement of his base-line, some miles west of Dehra [51–2]. He received under an official cover from the Political Agent an application regarding a pension, which referred to him by a term which to this day is used to denote any surveyor, but which he took as an

> offensive designation. ... I am not a Kumpass Wala, but Surveyor General and Supt. of the Great Trigonometrical Survey of India. These are the appellations by which my masters address me, and...no person has a right to withhold them from me [1, 155]. As I never apply nicknames to any other person, and studiously avoid giving offence to others, ... I have a right to look for equal courtesy in return, and I hope...you will...prevent such offensive epithets appearing in any public paper intended to meet my eye, or wherein I may be spoken of[2].

Young replied with the utmost tact that he did not notice anything disrespectful,

> 'compass walla' being the designation commonly applied to the Survey Department in this part of the country and, if for a moment I could have supposed it likely to give offence, I should have ordered it to be corrected. I feel convinced that no...disrespect could have been intended on the part of the petitioners, because they could not possibly gain anything by...insolence. ... I have given directions that no public document shall pass my office in which you are designated by any other title than Surveyor General Sahib Bahadur[3].

Everest asked for a yet more impressive title ;

> I never entertained the belief that you intended me any offence. ... I objected to a low, familiar, appellative which, though it may be in common use in the bazar, I cannot allow to be applied to me as my official designation. The Commissioner...always designates me in his parwanas...by the title of Surveyor General Kishewar Hind, which is a literal translation of that assigned to me by my masters. I shall be obliged by your adopting that designation[4].

Morrison now got involved with Henry Kirke, Station Staff Officer, and adjutant of the Sirmoor Battalion from 1828 to 1842. He later had charge of the Dūn canals, and held one of the earliest tea gardens in the Dūn [168–9][5]. The Survey Office stood in a large compound outside cantonments, the followers being housed in grass thatch huts in this compound. Kirke held office in his own residence in another large compound alongside.

The comedy started on 14th December by one of Morrison's mules, a wayward lady, wandering into Kirke's premises. Other incidents and sharp notes followed apace, and on 19th Morrison found the situation had got beyond a joke, and reported the whole sequence to Everest, with copies of all the correspondence ;

> This morning...a herd of cattle were in your grounds, ... destroying the huts recently erected by the people...employed under you at the base-line. The same cattle came almost daily...to feed upon the straw of which the temporary houses are composed, ... four of which I desired to be caught and tied up under charge of the sentry until the owners...should come forward. ... The four animals...had not been tied up half-an-hour ere I received note No. 1 of the enclosed correspondence from Lieut. Kirke, Adjutant of the Sirmoor Battalion. My reply, ... No. 2, may require a little explanation.
>
> On Sunday last, a mule belonging to me strayed into the open ground attached to Lieut. Kirke's house, which is immediately adjoining to mine, and was tied up. On learning this, I wrote a civil note to that gentleman requesting the mule might be delivered to my servant and offering to pay any damage she might have committed, vide No. 3. Lieut. Kirke's reply is marked No. 4, and on receipt of it I immediately sent the sum of two annas which he levied as a fine, ... and had her released. ...
>
> On Lieut. Kirke's cattle coming into my hands, ... I thought it but fair that he should release them upon the terms laid down by himself, ... but the case was now altered, and Lieut. Kirke, instead of following his own rule, ... ordered a havildar and four sepoys with fixed bayonets to enter your premises, and forcibly release the cattle, which was accordingly done

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[1] appd. Supt. of Dūn, 12-5-29; residence on site now occupied by Astley Bdgs. and old Gresham Hotel; country house at Nālapāni [III, pl. 3]. [2] DDn. 289 (175-6), 11-12-34. [3] DDn. 288 (286-7) 18-12-34. [4] DDn. 289 (177), 20-12-34. [5] (1806-57) ; Ben. Inf. ; Hodson, II (601) ; GBO. Lib., map A (1) ; Plan of Canal.

> in open day, and in defiance of the sentry under whose charge they were placed. I received from Lieut. Kirke at the same time the note marked No. 5, to which No. 6 is my reply. ...
>
> This is not the first time Lieut. Kirke has acted in the same spirit. Very recently, when... I was marking out the line of the new road leading to your office, he interfered on the plea of encroachment on his boundaries. ... I requested him to point out his boundary marks, and assured him they would be respected, but added that the work...could only be stopped by orders from you. ... He threatened to confine your people, and prosecute me in the Court. ... But the work proceeded quietly, and we heard no more of confinement and prosecution. ...
>
> The Station Staff pound to which Lieut. Kirke commanded me to send the cattle is the compound of his own house[1].
>
> Since my last letter...Lieut. Kirke has ordered the entire guard...on duty over the treasure and public property in your office to be relieved because the havildar made some demur about giving up the...cattle to the...sepoys with fixed bayonets. ... He has also ordered the havildar to drill for a month for permitting the sentry to take charge of the cattle at my desire.
>
> The new havildar...states that he and his men are to be under Lieut. Kirke's orders and not under yours. ... Lieut. Kirke has desired him to take charge of the treasure chest and nothing else, and has forbidden him to allow his men either to escort treasure from the public Treasury to your office here, or from the office to the...survey camp. The havildar has further been directed to report to Lieut. Kirke all orders that may be issued to him[2].

This was a chance that brought fire to Everest's pen. He drafted a trenchant, yet impeccable, report to the Adjutant General of the Bengal Army, asking that it should be laid before the Commander-in-Chief, and sent a copy of this draft to Young with a letter rather more freely expressed. Young knew how to put his "Station Staff" in his place, and Kirke gave his version of his official actions ;

> The guard on duty at the Surveyor General's office were constantly called upon to take charge of treasure, etc., to the Surveyor General's camp. ... No batta was drawn for them. ... I gave the havildar on duty instructions...that, in future, whenever any of the men were sent on treasure escort duty, he was to report...to me, in order that I might...obtain for the men what they are entitled to. ... The havildar...was never sent to drill. ...
>
> I have conveyed the following order to the havildar now on duty at the Surveyor General's office, i.e., that he is...accountable to Major Everest alone, and that he is implicitly to obey all orders conveyed to him through such channel as the Surveyor General may direct, and further that he is not required to report any circumstance to me[3].

Young then expressed to Everest his sincere regret that any circumstances

> should have induced an officer under my command so far to forget himself as to render an appeal...necessary to...the Commander-in-Chief. Whatever provocation Lieut. Kirke may have received from your Registrar, I cannot defend his conduct in...the misapplication of the... authority vested in him as Adjutant and Station Staff. ...
>
> I have deemed it incumbent on me to censure Lieut. Kirke, and I have...convinced him of the impropriety of his conduct. ... Lieut. Kirke...expresses his regret that any part of his conduct should have appeared to you in that light.
>
> I shall refrain from making any remark on the apparently exaggerated statements of Mr. Morrison, or the irritating tone...assumed by your Registrar throughout this affair (which would never have been tolerated by gentlemen of equal rank in society), because I consider it a matter of small importance, when Lieut. Kirke has...subjected himself to severe censure.
>
> Neither shall I dwell on the impropriety of placing cattle...under a sepoy guard furnished for the protection of Government stores and of your treasure. ... My object is...to prevent evil consequences to the interests of a zealous young officer which...I trust the apology contained in his letter, and the censure he has already sustained, will avert[4].

This early dispute with the Trigonometrical Survey did not prevent Kirke from naming his tea-garden "Arcadia", in honour of the Great Arc. This garden lay four miles west of Dehra, and two miles north of the east end of Everest's base line [52 ; pl. 17][5]. The cultivation of tea in the Dūn had been first proposed in 1827 by Dr. Royle, Superintendent of the botanical gardens at Sahāranpur, and in 1834 tea nurseries had been started "in the Garhwal Hills". In 1838 Dr. Falconer, who had succeeded Royle, reported the raising of tea at Sahāranpur. In that year grants of land for tea cultivation were issued to a number of British merchants, civilians, and military officers, including several officers of Young's staff besides Kirke[1], an irregularity that led to Government intervention[2] [220]. In 1844 a government plantation was started at Kowlagir, two miles west of Dehra, that in 1867 was sold to the Rāja of Sirmūr.

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[1] DDn. 288 (288-91), 19-12-34. [2] ib. (292-3). [3] ib. (296-7), 24-12-34. [4] ib. (296-7), 19-12-24. [5] *Meridional Arc* (xvii n.).

Everest had yet another dispute with Young, this time in his civil capacity as controller of excise. The survey followers had been distilling intoxicating liquor from jungle plants[3], thereby infringing the rights of the official contractors, who appealed for action by the Political Agent. Supported by an official letter and one of Young's *chaprāsis*, the contractor made what Everest called

> a rather extraordinary pretension, ... because the gathering of wild flowers or leaves, which no man has planted, seems to me common right of all. ... I do not see how I am to prevent such a practice. ... If you will...explain to me what the law is upon this subject, I will...cause it to be read aloud for general information, ... with the warning that any who violates it shall be sent to your court for punishment. The native...did not complain...that the noxious drugs...were illegally...sold. He complained...that the people of my camp plucked the wild leaves and compounded their own nastiness for domestic consumption.
>
> The native...called the native establishment of the G.T. Survey by the foul name of coolies, which is expressly contrary to the standing orders of this department [405, 408][4], and I hope you will...utterly discountenance that practice. ... I speak not of your chuprasis, because they are remarkably obliging, civil, and well conducted, but of the native towns-people generally.
>
> The native establishment of the G.T. Survey are called khalassies or lascars. If I were to call them coolies, I should not be able, as I do now, to enlist among them workmen and artificers of all sorts, and consequently they would not be half so efficient. ...
>
> I have serious objection to the open sale in my camp of prepared intoxicating drugs, and shall certainly do my utmost to prevent any being illegally vended. As to the establishment of an authorized shop, ... I hope you will not press it, for I have a great horror of all vendors, dealers, compounders, and retailers, of these poisonous drugs[5].

Two weeks later he acknowledged a letter from Young,

> acquainting me that the manufacture of intoxicating drugs, except under the authority of a license from Government, is unlawful in the Dhoon. ... That Government has granted a license... to Goolal and Goordial, and they are authorized to seize the illicit drug wherever they find it, and the possessors are liable...to fine or imprisonment. ...
>
> The native establishment of the G.T. Survey...all deny that they use the intoxicating drugs specified. ... I have given positive orders...to prevent any person...from manufacturing them in my camp; ... that the practice of privately making up unwholesome messes of the sort is illegal, and punishable by fine, and that any trees of the noxious tribe which are found growing near my camp or base-line are to be forthwith rooted up and burned.
>
> Your letter proceeds:—'whether it would not...check the consumption...—were I to permit the establishment of a regular shop in my camp—...of a drug which is as necessary to many of my establishment as a dram is to a European soldier, and equally pernicious if taken to excess'. ... Opinions differ respecting the necessity of a dram to an European soldier. ... The Temperance Society has the correction of that notion in view. ... In the Regiment to which I belong the European soldiers are debarred access to shops where intoxicating liquors or drugs are sold, and...a like prohibition is general throughout the army, the use of such articles being deemed destructive of order and health.
>
> Your letter proceeds:—'as the title by which the camp followers of the Grand Trigonometrical Survey of India are to be addressed...appears...to be a matter of importance', you will discontinue 'the foul appellation of coolies'. ...
>
> I never...see the merit...of addressing any man, or set of men, by a title which wounds their amour propre. More trivial causes...often give rise to serious affrays. ... It is because the native establishment of the G.T. Survey are orderly and well conducted that I wish to keep them aloof from all affrays. ... I...protest against the establishment of any such shop in my camp. ... The native establishment under my orders shall never be countenanced by me in the consumption or manufacture, legal or illegal, of intoxicating drugs[6].

Young then rather unwisely threatened to make report "through the Commissioner, ... to account for a falling off in the...revenue, which must inevitably follow if the example...set is followed by others possessing equal authority to oppose the regulations," to which Everest stoutly rejoined that he was

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[1] limits of the tea estates shewn in Brown's map of E. Dūn, dated 14-4-41; GBO. Lib. map A-3.

[2] *JASB.*, III, 1834 (178-88); Williams (280-3, 315-31; Appx. xlvi-viii).

[3] possibly the *ber*, or *zizyphus jujuba*, roots still used for distilling liquor in the Dūn.

[4] cf. Govt. of India order forbidding the official use of the term, 1950.

[5] DDn. 289 (185-6), 31-12-34.

[6] ib. (190-3), 12-1-35.

> not an opposer of the regulations, ... and have done nothing to merit an inference so injurious. I have been educated as a soldier from my earliest youth, and I know well...the value of subordination and obedience to my superiors.
>
> What regulation...is it that you tax me with opposing ? I have on two occasions...solicited... you to point out the regulations to which you referred, and you have not as yet complied. ... Let me see the regulations by which I am required to allow...a shop such as you propose in the camp of the G.T. Survey, and be assured of my instant compliance[1].

TRAVEL & TRANSPORT

Everest never saw either metalled roads or railways in India, but by 1830 there was a Department of Public Works, staffed by military officers, mostly of the corps of Engineers, that was largely occupied in the surveying and construction of roads [I, 10, 267, 269, 360], in which much interest was taken by the Quartermasters General of all three presidencies [III, 27 ; IV, 269]. Travel by *dāk*, for which relays of riding or carriage ponies, or palanquin bearers, were laid out in stages, was the speediest means of travel, and correspondingly expensive [III, 419 ; IV, 124]. Conditions varied considerably from one part of the country to another, and in 1843 the Postmaster at Agra reported

> that a dak cannot be laid between this station and Bombay, there being no bearers on the road. Travellers usually proceed by a dhawub dak[2], or by 30 men, who at a charge of 12 rupees each convey a palanquin at the rate of 40 miles in every 24 hours to Indore. Beyond that I have no information. Major Drummond's new road is open [269–70], and bungalows are, I believe, built nearly on the whole line, but none are under me[3].

Where river traffic permitted there was always the leisurely country boat. The following table is taken from one prepared by the Surveyor General's office in 1831[4] at the request of the Military Auditor General, by whom it was countersigned. It shows "the periods for which boat allowance is admissible to officers proceeding by water". The number of days allowed appears to be that for the journey up-stream, which would be greatly reduced for the down-stream journey.

	Agra	Calcutta	Cawnpore	Dacca	Delhi	Garhmukteswar	Mirzāpore
from Allahabad	55	75	15	75	80	53	7
Agra		130	70	130	25	108	62
Calcutta			90	30	155	128	68
Cawnpore				90	95	38	22
Dacca					155	128	68
Delhi						—	87
Garhmukteswar							60

For Morrison's journey up-country with the Surveyor General's office [163], a fleet of boats was requisitioned from the Commissariat. In order to start from Calcutta "with the afternoon tide of the 15th December (4 p.m.)", they were to be ready for loading "by daybreak on the 12th, in order that the public property may be carefully and leisurely embarked". The six members of the European staff[5] [165] were allowed three 14-oared and one 10-oared "budgerows", three 400-maund baggage boats, and four cook-boats. The Indian draughtsmen were allowed one country boat each, whilst followers and escort were allowed country boats at the regulation 25 maunds per man[6]. Two 500-mds. "Dhacca pulwars, boarded floors", were provided for instruments and records ; "these boats must be light, dry, and exceedingly sound, because the property they are to convey is of immense value, and cannot be replaced if injured. ... A pansway of 200 mds. [364] was added before leaving Calcutta". Murphy was allowed a 900-mds. "putillah" for himself and the instruments he was taking to Agra[7].

The fleet left Calcutta on 20th December presumably by the Sundarbans route [172], Morrison joining at Tardah, and reporting progress from place to place[8].

[1] DDn. 289 (194–5), 17–1–35. [2] *dhawa* = expeditious march. [3] DDn. 405 (177–8), 17–4–43. [4] DDn. 264 (100), 10–5–31 ; cf. Johnston (28–30). [5] Morrison, Dias, W. H. Scott, Cornelius, Logan, Ross. [165, 333, 337]. [6] about 28 mds. to a ton. [7] DDn. 266 (239), Nov. 1832. [8] DDn. 284.

Sicry Gully, 25th January 1833. The fleet arrived at Rajmahal yesterday. ... Our progress ...if not so rapid as could be wished has in all other respects been satisfactory. Since leaving Bogwangolah [I : pl. 14][1], from which place I dispatched a letter...to you...on the 16th instant, we have been much retarded by strong currents in some places, and nearly all the way by shoals and sandbanks, but luckily the public property boats have met with no accident.

The classies' boat was from the beginning a cause of delay, ... always lagging much behind owing to the crew being scanty in number and...feeble old men. She was, besides, a very crazy craft, requiring the constant labour of one man to bail out the water. ...

After leaving Bagwangolah, she struck against the bank in a strong current and injured her bottom. She leaked so much afterwards that the classies begged to be allowed to abandon her. We were at the time opposite to a complete wilderness, and far from any place where another boat could be procured. ... I directed the burkundauzes [II, 15 ; IV, 59, 411], who are few in number compared with the classies, to take up their quarters in the public boats, and the classies to take possession of the boat which they had vacated. ...

Altho' I had repeatedly forbidden fires...upon...the public property boats, yet, on visiting them unawares, I have found cooking going on in the very midst of the instruments. The burkandazes have been directed on pain of instant dismissal to prevent anything of the kind in future and, as they...do not, being Hindoos, cook on the boat themselves, one great danger may be considered as guarded against. ... At Bagwangolah we found a fleet proceeding upwards under charge of a conductor, who pointed out one of his boats that had been burnt down to the water's edge a few days before, through the negligence of the people on board. ...

The wind has invariably been against us, and sometimes blowing pretty and stiffly. The boats containing the instruments and records are all in good trim, and get on more steadily... than the private luggage boats, the latter not being so well laden. Perhaps when we reach Allahabad, some additional tonnage may be necessary, as we will there have to tranship many of the articles now on board of the Agra boat.

Patna, 15th Feby. ... At Monghier the several packets of General Orders, Calcutta Gazettes, and official papers...came...safely to hand on the 4th instant. During that day which turned out very wet and stormy, we remained at Monghier, and started again next morning, ... but the wind has been so directly against us ever since, and blowing so strongly from noon to the close of each successive day, that we have been 12 days in coming a distance which on two former occasions I easily accomplished in half that time.

As we proceed, I shall...apprize the different Magistrates when about to enter their districts. ... I am much obliged to you for the offer of the biscuits, and should my own stock run short... will gladly avail myself of it. ... Mr. Dias [333] is present with the fleet ; I found him at Tardah with the rest of the establishment, and glad enough he was to get away. ...

Many complaints have been made against the burkundauzes by the villagers for robbery and ill-treatment. I expected the new hands (the discharged sippahees) [37, 410-2] would be unruly subjects, and 2 or 3 have proved so. One man in particular, whom you remarked in Calcutta for his talkativeness, is a saucy and a useless hand. You desired me to whack them if they misbehaved, but instead of that I tried what effect depriving them of their badges far a time would have. It has repressed their marauding propensities, if no other good has resulted. ... I am glad to be able to speak to the good conduct of the old classies...and generally to that of the new men, temporarily engaged. ...

I have succeeded in procuring quarters at Mussoorie for...myself and family at a convenient distance from the office, and on reasonable terms [163, 165]. I proposed to Mr. Dias to engage a house for himself and the other people, ... and I offered to write up to my correspondent at Meerut on the subject, but the office folks generally...seem quite willing to trust to chance[2]. ...

Mirzapoor, 11th March 1833. We arrived here last night all safe and well, altho' in the early part of the day we had a severe north-wester, the approach of which, however, we had timely notice of. ... None of the boats sustained the slightest injury, and...as the storm subsided a breeze sprung up in our favour which carried us on to Mirzapoor at a famous rate. This is the first actual storm we have had, ... but the season for them is now at hand.

I sent for, and received, the several articles which you left here in Mr. Stewart's house[3]. ... They have been carefully stowed away on board of your private luggage boat.

Just as the boats were pushing off from the ghaut this morning, the burkundauz, Gheesa Khan, who absented himself so unceremoniously before we arrived at Patna, made his appearance, and was preparing to step on board of your luggage boat as easily as if he had merely been up to the bazar for half-an-hour. It was now 25 days since he went away, and 22 since a man was engaged in his stead. His account...is that he went to his country near Patna to see his friends. ... I have given him leave to go back and stay with them altogether. ...

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[1] 10 m. above Murshidābād. [2] DDn. 284, 15-2-33. [3] Hay Tweeddale Stewart, of Mirzāpur, *Ben. Dir. & AR.*; nat. g. son of Hon. Chas. Stewart, BCS. 1761, son of 7th Lord Blantyre.

Mr. Murphy will leave us at Allahabad [139]. I purpose detaching 2 burkundauzes and 2 classies with him...to Agra. I have desired him to report progress to you occasionally as he advances, addressing his letters to the Saugor Post Office.

Allahabad, 19th March. I have taken up a boat from the Commissariat officer here to replace the one we abandoned above Bogwangolah. We cannot put a sufficient freight on board of her, but she will prove a kind of reserve in case of accidents. Some few bulky articles from the Agra instrument boat have been removed to her, which might have encumbered the Saharanpore instrument boat. ... Mr. Murphy will address...you at Agra instead of at Saugor. ... We set out on our respective voyages tomorrow morning.

Curra-Manickpore, 20th March. We have got safely past the dangerous part of the river at and above Allahabad, where we found the current...more dangerous owing to its shallowness than rapidity. The boats took the ground every ten minutes, and it proved a work of great labour...getting them...over the many shoals...for the first six miles above Allahabad. ... Half of the fleet only advanced at a time, the crews of all the boats being put in requisition for the advancing portion who were thus doubly manned...until...the bed of the river was found to be comparatively deep and the current moderate.

We have had three north-westers since leaving Allahabad, the third and severest commenced about midnight of the 23rd instant. We expected it, and were consequently in... preparation. ... The whole fleet rode it...without sustaining the slightest damage.

He asked the Surveyor General to write to the transport officer at Meerut, requesting him to comply with my indents...for carriage...to Saharanpore and Mussoorie. ... 30 hackries [29] and 200 coolies will at the least be required, ... besides 5 sets of palankeen bearers for ourselves and families. The people...are aware that they will have to pay for... their private property, although the Commissariat will...supply the...men and hackries.

Futtyghur, 15th April, 1833. I beg to report...the safe arrival of the fleet at this place in 9 days from Cawnpore. ... The weather...has become so very hot that it is far from pleasant to be on the river now. ... Our progress...is but slow, owing to the zigzag course of the navigable channel of the river and the constant head winds. ...

On entering the Cawnpore District we found two burkundauzes waiting at the first thannah, who had orders from the Magistrate to accompany the fleet, ... being relieved at the next thannah by two other men, and so on regularly till we entered the Furruckabad District, where we are similarly attended. ... They are useful to us both as guards and purveyors. ...

Gurmucktesar Ghaut, 8th May 1833. I have...to report the safe arrival of the fleet...after a very tedious and unpleasant journey from Futtygurh. This...alone has occupied 23 days, 7 of which were entire halting days, owing to the strong winds that opposed our progress.

On the evening of the 23rd ultimo we were overtaken by a storm, which...far exceeded anything...before encountered. It appeared...perfectly miraculous how the boats held on to the shore. Every inch of rope...was made use of in securing the boats to the pins, but many of the latter were drawn, ... and it was only by...the greatest attention to them during the night that we managed to ride out the gale. ... On the night of the 4th instant we had a second storm as severe as the former, if not worse, ... with thunder and heavy rain. ...

We found Meer Mohsin in waiting at this place, with the carpenter and smith. ... Meer Sahib and his aids will be of great use, both here and in Saharanpore, and it accords with your usual consideration having sent them [129, 165]. ...

The tents...arrived here about eight days ago, and the carts and coolies are collecting. We will...start on our journey as soon as possible—Mr. Logan and the instruments towards Saharanpore [139]—myself, the office establishment, and records, towards Mussoorie [163][1].

Morrison thus took a full five months to reach Mussoorie from Calcutta. Everest had left Calcutta by *dāk* on 24th December, reached Mirzāpur the 2nd February, and Saugor on 3rd March. After inspecting Macdonald on the Budhon Series, and Rossenrode on the Great Arc, he reached Dholpur on 5th April, Muttra on 13th, and Mussoorie early in May.

As a contrast to the time taken by country boat, we quote Fanny Parks' account of her journey by river steamer to Allahābād. She left Calcutta on 6th March 1837. ... I went on board the "Jellinghy" flat [142], established myself and my ayah in a good cabin, and found myself for the first time located in a steamer. She quitted Calcutta in the evening. ... Obliged to go round by the Sunderbunds. The steamer herself is not the vessel in which the passengers live. Attached to, and towed by, her, is a vessel as

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[1] DDn. 284.

> large as the steamer herself, called a flat, built expressly to convey passengers and government treasure. It is divided into cabins, with one large cabin in the centre in which the passengers dine together. ... 29th March, arrive Allahabad[1].

The service of river steamers on the Hooghly and Ganges had been started on the initiative of James Johnston, formerly of the Royal Navy, who had brought out the *Enterprise* from England in 1825. In 1829 Johnston was placed in temporary command of all the steamers on the Bengal rivers under the Marine Board[2], and in 1830 he was sent home to advise on the design and construction of steamers suitable for navigation of Indian rivers. Returning to Bengal in July 1833, he was appointed Controller of the Company's Steam Vessels at Calcutta[3], a post he held till he retired in 1850 [III, 419 n.4 ; IV, 142 n.6].

Transport for the long and constant marching of the field season was as a general rule obtained from the commissariat department, though sometimes hired direct by the surveyors. The marching and counter-marching by officers working on the Great Arc between 1833 and 1841 occupied a formidable number of days, covering a distance of more than 1000 miles between Mussoorie to the north and Bīdar to the south [42, 112]. So far as possible Everest arranged that he and his assistants had observations of some sort to carry out during these long marches. To speed up his own journeys to Sironj and back during 1837–8 he got special sanction to travel by *dāk* and to charge the expense in contingent bills[4].

Journeys on transfer could be a great source of embarrassment, as was realized by Armstrong when in 1841 he was ordered from the Ranghir series at Fatehgarh to join Waugh on the Great Arc. Being directed to move at once by the shortest route at his own expense, he begged to be allowed to travel by river down to Calcutta, by sea to Masulipatam, and thence by road to Hyderābād, in order to save

> the expences of a land journey, and to obviate the...difficulties...encountered in travelling ...across a wild and mountainous tract. ... In my straightened circumstances...my most strenuous endeavours must be exerted to execute the journey with the least possible expence. Such...will scarcely be attained by pursuing the ordinary route via Saugor and Nagpore, when, independent of the difficulties of obtaining carriage for such a long journey, the rate of hire is so high, and the outlay...to purchase the cattle far exceeds my small means.

An advance of pay could only be made, wrote Everest, "from my private funds, and if I were to concede this to you, all others would expect a similar concession before they would set about obeying my orders". Armstrong persisted that, although

> most willing to proceed, ... I crave the indulgence of doing so (since I am to execute the journey at my own expence) in a manner commensurate with the means at my disposal, and with the health of myself and young family, who are not...so inured to the inclemency of the season and the inconveniences of life as I am. ...
>
> To perform the journey...via Saugor and Nagpoor the only hired carriage available are carts. Ridding myself of all superfluities, I shall require 3 carts at the least for my baggage ; at a monthly expenditure including return hire of about Rs. 40 each, the total expence for the whole journey would average 300 Rs. Besides this, there are other contingencies that (as I must convey my family with me) will not amount to less than 200 Rs., and in the aggregate would form a total of Rs. 500 at a minimum. ...
>
> The same journey by water via Calcutta and Masulipatam would stand me as follows :—

Boat hire from hence [Fatehgarh] to Calcutta	Rs. 125
Passage on a...coasting vessel...from Calcutta to Masulipatam ...	75
Land carriage...to Hyderabad, 14 marches, say @ Rs. 5 per march	70
Total expences	Rs. 270

> ...By the river conveyance there will be a saving to me of about half my salary, omitting the consideration of comfort, inclemency of the season, wear and tear of property in course of transit by land. ... My passage to Calcutta would occupy at most 40 days ; from thence to Masulipatam (including detention at Calcutta...) 10 days ; and say 20 days from date of arrival at Masulipatam to reaching my destination, making a total of 70 days, which is... something below the period which will be occupied by the Nagpoor route[5].

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[1] Parks II (102–5) cf. ; Anne Deane (270). [2] BPC. 5–5–29 (34–6). [3] ib. 2–9–33 (3–4). Reports by Johnston ; London, 1831, *IO Cat.* (111–2) ; Calcutta, 1837, *JASB.* x, 1841 (538–40 ; 544) ; Johnston (28–30). [4] also for Mohsin Husain 1839–40 [124]. [5] DDn. 434 (159–63), 6–4–41.

Though shocked at Armstrong's threat to resign if his request was refused, Everest obtained authority for the sea journey[1] and Armstrong got what he wanted.

In 1841 Everest was called to Simla on duty [118], and took the opportunity to inspect Boileau's magnetic observatory. He travelled by the hill route from Mussoorie that was little known in those days, taking W. N. James, an Indian doctor, 108 *khalāsis*, 8 *harkaras*, 2 artificers, 69 servants, 6 horses. No mention is made of transport, so probably his baggage was all carried by the *khalāsis*. Leaving Mussoorie 15th September, the party reached Simla 29th[2]. The 14 halts may recall memories of a delightful journey to any who have travelled this way.

> Mandarsu — Besu — Makhti-ki-Pokhri — Than Toongra — Deobun — Bundrowlie — Kandha — Tons Bridge — Peuntra — Chepal — Putun Nulla — Dussowlee — Goond Rana's Durbar — Fagoo.

For his last journey down the river to Calcutta, with the whole establishment and baggage of his field headquarters, Everest applied to the Chief Commissariat Officer at Meerut for transport down to Garhmuktesar, as well as for the river journey onwards. As might be expected, there was much heated correspondence over the arrangements. Work was carried on right through the journey and at Fatehgarh Everest issued orders for the "computations proceeding on the office boat" [112];

> After the hour of 5 p.m. no boat is to precede that of the Surveyor General which will be the foremost to draw ashore, and select the landing place for the evening. After the Surveyor General has chosen the sites suitable for his own, and the boats containing public, property, then, and not till then, the other boats of the fleet will be at liberty to take up their posts. ...
>
> The office and guard boats, and those conveying the public property are always to keep as near the Surveyor General's boats as circumstances will admit[3].

Everest was far from satisfied with his allowances drawn for the journey, and re-opened the claims he had made ten years before [328–9];

> The letter...dated 28th August last rendered it imperative on me to proceed by water. ... The nature and the condition of the boats...at Garhmucktesar Ghat are, I presume, too well known...to need...any detailed description. ... Miserable barges greatly resembling floating haystacks—pervious to rain—close—foul—and uncomfortable—are alone procurable at the ghat, yet the proprietors...will not hire their wretched craft on the conditions laid down... as remunerative to me. ... Even for this inferior accommodation I have...to pay a sum nearly double of that which has been granted. ...
>
> It is entirely attributable to my own unwearying exertions...that my fleet was enabled to perform the journey from Garhmaktesur Ghat to Calcutta in 34 days, instead of 2 months and upwards, the time usually allowed. ... A boat was supplied by the commissariat at the public expense for the office of the Surveyor General, but none was...supplied for the Great Trigonometrical Survey office and records. ...
>
> Whatever doubts may exist as to the matter of office rent [165], ... I am decidedly entitled to the whole sum drawn for boat allowance, viz., for 4 months and 8 days from the time of the sailing of my fleet from Garhmaktesur Ghat [170][4].

Communication with England was greatly speeded by the opening of the overland route, and in *The Times* of 29th November 1838 it is recorded that

> letters and papers were received yesterday from the East Indies by way of Egypt and Marseilles, the dates being of the 23rd of September from Calcutta, and the 6th ult. from Bombay, making the whole transit from the latter place 53 days only.
>
> The merchants owe the rapidity of it, however, chiefly to the arrangements of Mr. Waghorn in Egypt, who takes advantage further of the post through France. ... The journey through Egypt from Suez to Alexandria is said to have occupied, in this instance, but five days.

In 1825 Thomas Waghorn had, as a Hooghly pilot, taken the steamship *Enterprise* up the river to Calcutta on her arrival from the historic voyage from England [III, 419; IV, 173]. Learning from Johnston of his earlier journey across Egypt, Waghorn took up the idea of this overland route with such enthusiasm that he was sent to England in 1827 to seek public support in developing it. Returning to India in 1829, he was back in England when arrangements were made that year for the *Enterprise* to make an experimental voyage from Bombay to Suez and was deputed to carry despatches from London to meet the *Enterprise* at Suez.

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[1] DDn. 402 (152), 15–4–41; BMC. 12–5–41. [2] Tons bridge built 1834–5; road with bungalows, 1848–50; DDn. Mgte. 115. It is not clear that Everest followed this exact route; W. R. James, son of W. N. recorded obsns., GBO Comp. F-17/61. [3] DDn. 356, 22 & 26–10–43. [4] DDn. 452 (50–2), 9–12–43.

> He travelled post across Europe to Trieste ; took sailing ship to Alexandria and dhow up the Nile to Cairo, and hurried over the 100 miles of desert to Suez, arriving there on December 8th 1829, the day the Enterprise was expected there. She failed to arrive and Waghorn embarked himself and his dispatches in an open sailing boat, and set off down the Red Sea, with what must have seemed a forlorn hope of finding her. This venture...is depicted...on the base of the statue to Waghorn which now stands at the Suez entrance to the Canal. ...
>
> The Enterprise had broken down, and when Waghorn was picked up by the E.I.C. brig Thetis off Jeddah, it took him until March 20th to reach Bombay, four months 21 days from England, or about the time of a good passage by an Indiaman round the Cape[1].

In January 1835 Waghorn returned to London, and offered to take letters overland at five shillings each, making the return journey once a year. He spent the next few years in developing facilities for carriage of passengers and mails across Egypt, by camel and coach, reducing the coach journey across the desert between Cairo and Suez to 36 hours.

In 1837 the "Peninsula[2] Steam Navigation Company" started a regular service of wooden paddle steamers, and the *Don Juan*, 933 tons, left London on 1st September with mail for the East Indies via the Mediterranean. Later ships cut the voyage from London to Alexandria to 12 days, whilst four days were allowed for the land journey to Suez via the Mahmudiyah canal, the Nile, and the desert.

In 1840 the company added "Oriental" to its title, and obtained its royal charter on condition that the service was extended to India within two years. The paddle steamer *Hindostan*, 2017 tons, leaving Southampton on 24th September 1842, was the first P. & O. steamer to reach India by the Cape route.

The following timings between London and Calcutta—selected at random—show the immense change effected by Waghorn's overland route—1830, Cape route, 129 days—1835, Cape route, 144 days—1840, Overland route, 60 days—1848, 36 days[3].

MEDICAL AID

Although an Indian assistant surgeon was provided for the Great Trigonometrical Survey whilst Olliver held charge, and was kept on at Everest's headquarters, no regular provision was made for other field parties. They had to look for medical aid to the nearest civil or military stations, and were occasionally able to borrow an Indian medical subordinate when working in a particularly unhealthy region. In spite of Everest's repeated attempts to have a European medical officer appointed to the survey as Voysey had been [III, 225, 508–10], this was sternly refused[4].

In 1833 Macdonald writes from Saugor that his party had

> not escaped from the fever which has been epidemic at this station for the last month, and... some of the sub-assistants (of whom three are now on the sick list) may not be able to march so soon as I propose. ... I...request you will obtain from...the Medical Board...an educated Native Doctor to be appointed to the Boodhon series. During this sickly season the establishment has had the best native medical attendance, but the native doctor, who cannot leave this station, can only furnish a very inadequate substitute to accompany us in the field.

Everest agreed that it would be unwise to take the field too early;

> I shall apply for a native medical man for you. ... I should for my own part prefer a native leech of respectability, if it were not for his ignorance of European medicines, but where his own materia medica is used, he is just as likely to work a cure as any but a first-rate physician[5].

The South Parasnāth series probably suffered as much as any other party, as shown by the following extracts from Boileau's letters[6] [60] ;

> 21st May 1836. In consequence of the great sickness in camp, and my own indisposition, I have been obliged to discontinue work for the season, and quitted the hill station of Purara near Manbhoom today, in progress towards Bankoora and Midnapore. The native doctor and

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[1] *The Times, P & O Centenary No.* 47,783, 7-9-1937 (viii).

[2] the Iberian, or Spanish, peninsula.

[3] *The Times*, 29-11-1838 ; *Indian Mail, passim* ; 1848 (584).

[4] from Mil. Dept. 7-1-35 ; DDn. 285 (161).

[5] DDn. 372 (77-80), 1-10-33.

[6] DDn. 370 (4-40) May 1836—April 1838.

> about half the establishment, with two-thirds of the sepoys and burkandazes, have been sick, and one of the carriers died on the 12th instant.
>
> 1st August 1836. [He asked for] a medicine chest divided into proper compartments in which the various bottles...may be secured. ... In addition to my own large establishment, I have already afforded medical aid to hundreds of the poor villagers who sometimes come from a considerable distance to obtain it, so that the medicine chest is in constant requisition.

Early in 1838 he sent the whole escort back to Midnapore, with the havildar, the naik, and 9 sepoys on the sick list, with but three healthy sepoys to help them in. A month later, 7th April, he was carrying on by himself,

> Mr. Brown being still absent on medical certificate, and Mr. Kallonas...so ill with fever that I have given him leave to go to Midnapoor. ... Out of 46 public servants, 47 private domestics, with 14 soldiers, or 107 persons in all, I can only muster 18 healthy people on this hill top, and 27 others who are absent on command, leaving a balance of 62 persons unfit for hard labour. Four of the camp followers are dead. Not a single soldier is present in camp. ... Two of the burkandazes are said to be "pretty well", that is to say, they can keep watch sitting, being too weak to stand two hours at a time. The whole of my table servants, syces, grass-cutters, dhobies, and about half-a-score of bearers, are sick.
>
> [five days later]. The awful sickness in camp has compelled me to quit...Karramburree, though not until the native doctor fell sick, and I myself began to pass blood. We leave...for Midnapoor tomorrow, having 15 dhooly loads of very feeble folk, besides 21 others who are barely able to walk. ... We shall be very fortunate if we reach cantonments without any more casualties [III, 231].

He reports his arrival at Midnapore on 18th April,

> with the miserable remains of the Parasnath establishment, having been obliged to discontinue this season's work on account of the severe sickness. ... Eight...are already dead ; two more are missing, and some of the others are seriously ill. Mr. Kallonas is...also in a dangerous state.

Boileau had himself taken sick leave to China during 1837, and was not sorry to slip away from the survey before the end of 1838 [60].

During 1834 Everest obtained the servicesof "Dr. Gray, the medical gentleman at Dera[1]", to attend his establishment, with "a personal allowance of 50 sonat rupees per mensem". He asked for a whole-time European doctor, preferably Dr. Falconer "a gentleman of high scientific attainments", but without success ;

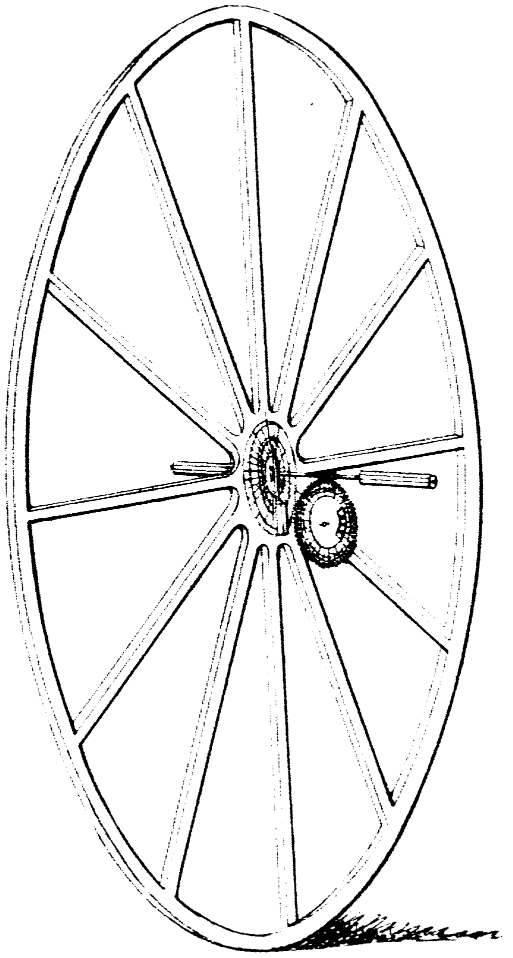
> If the G.T. Survey remained...quietly...in cantonments, it might be...easy for Dr. Gray to afford us medical aid without neglecting his other duties. But...we are an active and stirring set. ... Since the 10th November—the whole of the establishment...encamped...12½ miles from Dehra [51–2]...—Dr. Gray...has been unable...to pay one single visit to my camp.
>
> The native doctor...Shekh Gazi, though doubtless originally well instructed at the Medical Institution, seems to have become excessively stupid and inactive, and...all my sick come to me to be cured. ... My skill in medicine and surgery is far over-rated by these people, and if a serious case were to arise I should not know how to proceed. For example, a case of dysentery or a limb dangerously fractured would be too much for me. It is worthy the consideration of Government to nominate to the medical charge of the G.T. Survey...some gentleman in whose practice I can confide[2]. ...

He found the little-appreciated Sheikh Ghazi to be better than none, and recommended that he should be kept on permanently on his up-country salary.

> On the...breaking up the establishment of the Great Arc, I...solicit...to retain one of the two native doctors, Shekh Gazi, at my headquarters for...care of the medicines and...the sick. My own constitution is a great deal broken, I have frequent attacks of illness, and this individual has been almost my sole medical attendant for many years[3]. ... He is intimately acquainted with the habits, usages, constitutions, and diseases of all belonging to the G.T. Survey[4].

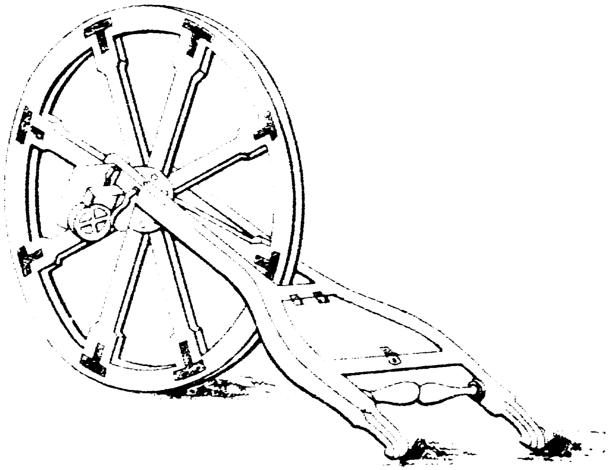
[1] Duncan McQueen Gray, Asst. Surg. Sirmoor Rifles ; allotted land for tea cultivation, 1838 [168–9].
[2] DDn. 286 (173–4), 12–12–34. Hugh Falconer (1808–65) ; Ben. Med. ; botanist ; in ch. Botanical Gdns. Sahāranpur [168].
[3] DDn. 402 (256–767), 1–3–42.
[4] to MAG. 7–12–43 ; DDn. 453 (101–3).

SURVEY PERAMBULATORS



Madras Pattern 8-mile Perambulator—as introduced in 1780 by the Madras surveyor John Pringle [I, 307–8]—consisted of a wheel about 7 feet in diameter, fitted with differential brass axle plates worked by an endless screw. The dial recorded revolutions in terms of miles, furlongs, and yards. Many improvements were introduced later [I, 199 ; II, 228 ; III, 219 ; IV, ch. ix].

It was easily propelled by two men with handles passing through axis about breast-high, but it was not suited to rough ground [Thuillier & Smyth, 107–8].

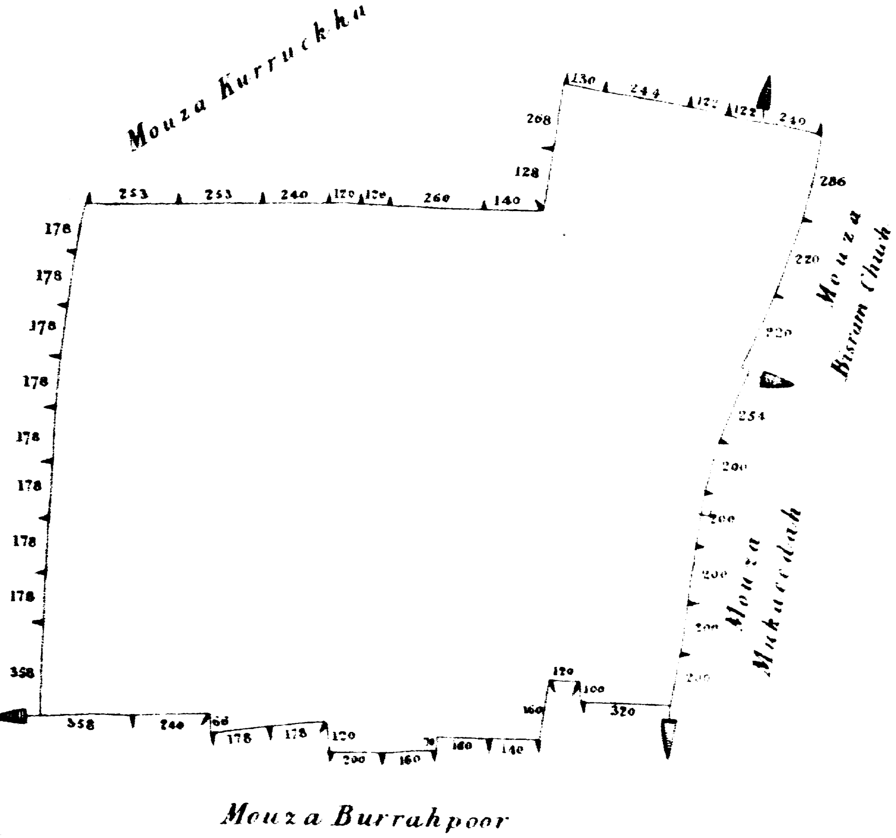


Everest Pattern 6-mile Perambulator—devised between 1832 and 1836—had a wheel of diameter just under 3 feet, with differential dials reading to miles and decimals of miles.

The wheel was made strong and handy for work over rough ground, and specially heavy so that it would be easier to wheel on the ground than carry idle on the head or shoulder [IV, ch. ix].

North

Specimen of Thakbust Map
Mouzah Mooseyharee
Puryunnah Manghee
District Sarun.



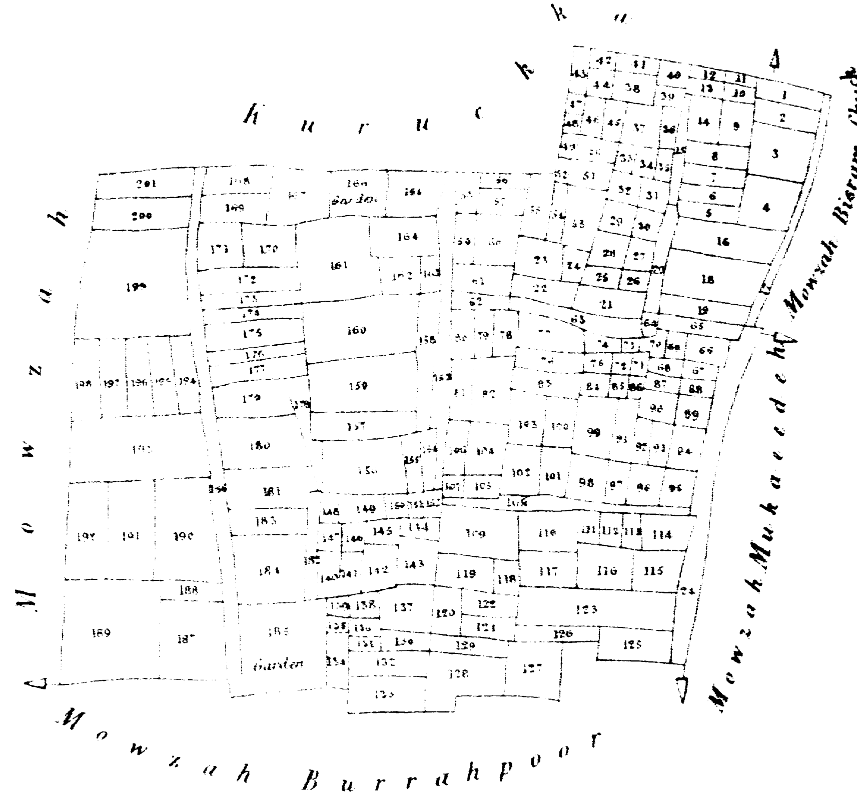
The distances are given in feet

Syed Naseeralies and
Dyal Chund Ameens.

South

(Signed) C. Chapman.
Civil Supt. of Survey

Specimen of Khusrah Field Map,
or Shujreh
Mouzah Meschreemockhrah
Purgh. Manjhee Zillah Sarun



Shughumlall Ameen

The thakbast was prepared before survey by the
revenue staff to shew positions and mutual dis-
es of all boundary marks [ch. xi].

Reproduced from plates XIII and XIV of *Manual of Surveying for India.*

The *khasrah* map, or *shujrah*, was prepared
the measurer, or *amin*, under the direction of t

CHAPTER XI

REVENUE SURVEYS—BIHĀR & ORISSA

Policy & Programme, Lower Provinces[1] — *Bihār 1835–43* — *Orissa 1837–43* — *Midnapore, 1838–43.*

IN the lower provinces of Bengal the country was broken up into estates, or *mahāls*, owned by *zamīndars* who, under the permanent settlement, either paid rent in a lump sum on the whole estate, or held their land rent-free as *lakherāj* or *jagīr*. These estates might cover any number of villages or parts of villages [227]. Outside these estates were ownerless waste lands and government-owned estates, or *khās mahāls*. The area covered by an estate might constantly change, but not so the boundaries of a village, or *mauza*[2], though they might be disputed [205].

The permanent settlement of 1793 applied to all districts of Bihār and lower Bengal, which at that time included Midnapore and Sylhet. It was never extended to Balasore or Cuttack which were not occupied till the conquest of Orissa in 1803 [II, 23], nor to Assam and Cāchār which were taken over between 1825 and 1830 [III, 52–65], nor to the Ceded and Conquered Provinces of Upper Bengal, which fell to the Company between 1801 and 1805 [II, 26 n.1, 47 n.12 ; IV, 8].

The fact that a district had come under permanent settlement by no means prevented the need for revenue maps or surveys within its borders, nor ensured that Government would draw the full revenues to which it was entitled. There was no record of the limits of the original lands included in the settlement, nor any sure means of ascertaining the area of new lands brought under cultivation and liable to further assessment. Disintegration or consolidation of estates occurred continually by laws of inheritance and by sales. It was impossible to verify the true limits of estates that lapsed to Government in default of rent. Rent-free lands expanded by mysterious means. Government was always the loser [7, 179]. The permanent settlement was not based on maps or precise surveys, but on the rough records of the last decennial settlement[3] [I : 140–1 ; II, 177–8 ; III, 6, 134].

A strange story came from *pargana* Amrābād, Noākhāli. In 1793 settlement had been made with 1,589 small *tālukdars*[4]. When estates came on the market and failed to find purchasers, they were purchased by Government as *khās mahāls*. The sale transfer was duly registered and the holder thus released from rent, though he continued to cultivate the land, which could be identified on no map.

The original assessed revenue, or *sadr jumma*[5], of the whole *pargana* had been over Rs. 91,000. By 1841 Government had acquired 355 *tāluks*, assessed at nearly Rs. 34,000, whilst another 222 had never been taken up. Out of some Rs. 46,000 a year due on the remaining land, the annual collection for the last five years averaged "considerably under Rs. 20,000". The lands sold to Government had apparently been secretly sold for cash to the holders of the other *tāluks*.

> Lands of upwards of 50 taluks have disappeared. Estates still continue to fall in ; bidders do not come forward ; the Government is obliged to buy, and in no case is the jumma under khas management found to equal the jumma paid previous to the sale. ... A considerable portion of the pergunnah has been measured, but...all that a measurement...can do is to shew the extent of the land of which we have succeeded in obtaining possession. It will not shew what we ought to have, nor by whom our just rights have been usurped[6].

---

[1] Narratives of early revenue surveys in Lower Provinces will be found in *Report, 1851–2 ; & Gen. Report, Rev.*, 1863–4 (i–xxxii), with map, by H. L. Thuillier. [2] a *mauza* might be quite uninhabited (227). [3] of 1789-90, or earlier. [4] village-holders. [5] due from cultivators on the estate. [6] from Comnr., Chittagong, BRC. 13–7–41 (27) & 2–11–41 (32).

This state of affairs had long been recognized, and before 1830 special surveys had been put in hand under the civil Commissioners—Bihār—Sundarbans—Bhulua or Noākhāli—Chittagong—Sylhet—Assam [III, 137–46]. Other surveys were called for, and in 1842 the Revenue Board explained that they all had

> this one great desideratum, the ascertainment of the relation of land to jumma. In many Bengal districts the Collector's registers shew nothing more than the name of the estate (even the name is sometimes incomplete and undefined), and the jumma paid for it. The villages, or portions of villages, of which it consists, ... frequently scattered in different pergunnahs, ... are known perhaps only to the proprietor or his agents [220].
>
> In Eastern Bengal compact estates are rarely met with ; the intermixture of property... is almost universal. The facilities to fraud...are too obvious. ... Government have already... found themselves in the predicament of having purchased a nominal estate without the possibility of tracing the lands which should belong to it. ...
>
> In Behar...irregular separations, with arbitrary allotments of jumma, occurred in some districts...within the first ten years of the permanent settlement ; while in others great confusion and injury...were occasioned by the no less irregular...consolidation into single mehals of villages which had been separately settled, but stood recorded in the Collector's books under the names of the same proprietors. ... These are the leading causes which induce the Board...to recommend the extension of the survey into the settled districts[1].

In 1830 the surveys still in progress were—Rājmahāl under Henry Tanner—Sundarbans under Alexander Hodges—Sylhet under Thomas Fisher—Assam Valley under Paulet Mathews. These were controlled by the Sadr Board of Revenue, Lower Provinces, at Fort William, whilst those in the western, or upper provinces, which later became the North Western Provinces [I], were controlled by the Sadr Board of Revenue, Western Provinces, from Allahābād[2].

To counter misrepresentation and to encourage co-operation, a notice was promulgated declaring the purpose of these professional surveys to be the making of

> a correct map of the country, ... defining the boundaries of estates, and thus putting an end to much of the...litigation, usurpation, and trespass. ... The present survey...has not...any purpose of enhancing the rates of assessment, or of disturbing...the rights and interests...of any zemindar holding his estate in virtue of the decennial settlement [I, 139–40 ; IV, 191], or any subsequent settlement made with the British Government.
>
> As the survey has for its object solely the protection of the people in the possession...of their estates, the prevention of disputes, and the better administration of justice, ... it is the more incumbent on all, ... so soon as the survey reaches their pergunnah and estate, to attend... the survey parties, and give their cheerful...co-operation in pointing out their boundaries, erecting boundary marks, and other duties[3] [187, 213].

The following surveys came under the administration of the Revenue Board of the Lower Provinces between 1830 and 1843 [287][4].

Sundarbans ..	taken over by	Hodges	in	January	1828	closed	1835
Chittagong ..	started by	Siddons		October	1834	„	1843
Pharkaya, Monghyr ..	„	Egerton		December	1835	„	1837
Monghyr & Bhāgalpur ..	„	Ellis		January	1837	„	1840
Jaintia, Sylhet, & Cāchār ..	„	Thuillier		January	1837	„	1842
Tippera ..	„	Phillips		November	1836	„	1842
Puri, Orissa ..	„	Trower		January	1838	„	1841
Cuttack, Orissa ..	„	Smyth		December	1837	„	1842
Balasore, Orissa ..	„	Fitzpatrick		March	1838	„	1842
Hijli ..	„	Egerton		January	1839	„	1841
Midnapore ..	„	Mathison		April	1838	„	1844
Rājmahāl & Purnea ..	„	Shaw		..	1840	„	1847
Bihār or Gaya ..	„	Stephen		January	1842	„	1843
Patna ..	„	Maxwell		December	1841	„	1843
Assam, lower ..	taken over by	Hudson		November	1832	„	1842
Assam, upper ..	started by	Thornton		November	1838	„	1842
Assam, Mattack Tea Area	„	Morton		February	1841	„	1842

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[1] from Rev. Bd., LP. BRC. 24–10–42 (11, 13). [2] Sadr = chief. [3] BRC. 2–11–41 (76). [4] *Ben Rev LP*., 1857–8 ; Narr. by DSG. 2–4–59.

Methods of survey varied widely from district to district to suit local conditions. In districts under the permanent settlement, the survey was concerned mainly with the boundaries of the estates or *mahāls*, not with those of the *mauza* or village area. The *khasrah* survey and register of cultivated fields by *amīns* or surveyors was only required in special areas, such as estates purchased by Government, and was usually carried out on contract under the professional surveyor.

Boundaries had to be settled and demarcated beforehand by Deputy Collectors working under the Collector of the district, or a specially appointed Settlement Officer, who classified the lands and their crops, and settled the revenues. Failure to demarcate boundaries in advance invariably led to serious delays in the survey. In some cases the settlement of boundaries was left to the surveyor who was then given judicial powers to facilitate dealings with *zamīndars* and their agents [189, 195, 207]. The Revenue Board noted that in Orissa

> the demarcation of boundaries in the settled pergunnahs will be a matter of little difficulty. Lieutenant Thuillier is...undertaking it himself in Pooree. In Balasore a single Deputy Collector will be employed, and in Cuttack the Surveyor will himself mark off the boundaries of the settled mehals, ... a Deputy Collector...those of the three unsettled pergunnahs.

Up to the end of 1837 all these surveys were administered directly by Commissioners of Divisions, under the control of the Revenue Board, but, for the new surveys being started in Tippera and Orissa, the Board asked for the assistance of Bedford, then in charge of the revenue surveys of the North-Western Provinces. Bedford moved to Calcutta in January 1838, and was in due course transferred permanently to the Lower Provinces. He found survey conditions very much more difficult, and listed the following causes of a permanent character

> which preclude...the surveys...in Bengal keeping pace with those of the N.W. Provinces.
>
> First.—Minuteness of the holdings and fields, and great extent, ... which increase the labour and cost of every part of the professional work and...the contract rates for the khusrah measurements, besides entailing extra expense for the salaried purtalling...parties. ...
>
> Second.—The great unhealthiness of most of the tracts under survey, which as the warm weather approaches more or less cripples every survey party.
>
> Third.—The detached nature of almost every survey, except those of Cuttack, which occasions great loss of time, and materially curtails area.
>
> Fourth.—Brief surveying season of little more than 5 months, whereas in the Upper Provinces the field work generally lasted from 7½ to 8 months. ... The most expensive portions of the establishments are necessarily kept up during the recess.
>
> Impeding causes of a local or temporary character ;
>
> First.—Occasional floods, which...prematurely closed nearly the whole of the Bengal surveys ; unusually early rains in 1839 also prevented any field work after the end of April.
>
> Second.—Want of timely orders for new work...seriously impeded progress [184, 187, 189].
>
> Third.—No attendance of...persons to point out the boundaries as defined. ...
>
> Fourth.—Want of longer experience...of the majority of the Bengal surveyors and their establishments compared with those of the N.W. Provinces[1].
>
> Some of the North Western surveys give a return of from 1,500 to 2,500 square miles [216–7, 234]. The return of a practised and efficient Bengal Survey may be...from 5 to 600 square miles which...may be considered equal to 800 or 1,000 square miles in the Western Provinces. ...
>
> An efficient Bengal Survey should not cost more than from 30 to 35 rupees the square mile, and Major Bedford calculates that from the shortness of the working season a Bengal Survey must always be 1/3rd more expensive than one in the North Western Provinces. The average rate of the N.W. Surveys in 1836–7 was nearly 21 rupees the square mile[2] [234].

The transfer of two parties from the western provinces to Bihār in 1841 [184, 229] gave an opportunity to review the systems followed in the two provinces, and, writes the Revenue Board from Fort William ;

> The questions discussed...are two :—First, the plan of the professional survey—and secondly, the adoption of the khusreh, or native measurement, as part of the operations.
>
> The Western Board object to the *mehalwar* plan of survey [227], ... that it would be in certain cases 'a mere topographical survey, utterly useless either for the protection of the people, or for obviating loss to the Government'. ...

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[1] from DSG. 12-6-40 ; Rev Bd. LP. 24-6-40 (73). [2] ib. (74).

> It is a question entirely of time and expence. ... There are in many districts of Bengal large estates comprising perhaps 100 or 200 villages in a common boundary, while in another part of the same district the lands of 7 or 8...mehals may be intermixed in the greatest confusion within the limits of a single village. ... Instances of both kinds abound in Midnapoor, ... and...a mere outline boundary survey was made of the settled pergunnahs or mehals of the Hijellee portion of the district [188–90]. ...
>
> With respect to Behar, however, which is the subject more immediately in hand, ... the Board eagerly embrace this opportunity of ascertaining the village boundaries and areas, with the view...of meeting the wishes of the people by restoring the several mouzahs to the independent status which they occupied on the rent roll of the permanent settlement. ...
>
> As regards Behar, therefore, this Board entirely concurs...that the professional survey should be mouzahwar[1].

In most areas covered by permanent settlement it was considered unnecessary to incur the expense of a *khasrah* survey in addition to the professional survey of the boundaries, Government having no interest in the rent collected from individual cultivators. The Directors were informed that

> the Sudder Board...at first contemplated that the survey should be mehalwar, that is, confined to a definition of estates paying revenue to Government, instead of mouzahwar, comprehending the definition of all minor tenures, similar to the survey of the North Western Provinces. ... Besides the...outward boundaries of estates, all extensive...waste, the course of rivers, roads, and embankments, and the sites of villages, should be included in the survey.
>
> In a fiscal point of view, the question was only between Government and its tenants-in-chief, and, as...the main object was...to ascertain...the precise extent...of every mehal, ... they deprecated inquisitions into...rights of individuals. At the same time the Board admitted that a mouzahwar, or village survey, which delineates all the permanent divisions...would be more ...useful. As far as Behar was concerned, they recommended that the survey should be made mouzah by mouzah. The settlement of the Behar District (now Behar and Patna) was originally mouzahwar. By orders of...1801 many component mouzahs of the present mehals, ... were consolidated, and the Board thought that now would be the time to restore these mouzahs to the independent status which they occupied on the permanent settlement.
>
> As being the more complete measure of the two, my sanction was given to the mouzahwar mode of survey, the Jungle Mahals[2] being, however, excepted.
>
> The adoption of the khusreh, or native measurement, as a part of the survey...was also discussed. The Western Board contended that the kusreh was requisite for the protection of the Government...as well as for the benefit of the people. ... The Lower Board allowed that ...the kusreh would be good, but...a large expense. ... The boundary of the estate being delineated, and the gross area given, the detail measurement might be superadded at any time by the expense of the parties concerned. ...
>
> Mutations of property by public and private sale, and by sub-divisions under the law of inheritance were so frequent that the map and kusreh would be of no use for such purpose [177]. If required by a Judicial court, the measurement should be made at the expense of the party benefitting by it. ...
>
> I thought it better not to sanction the khusreh[3].

This was approved by the Directors, though in 1842 some *khasrah* surveys were proceeding in all the Orissa surveys as well as in Midnapore and Bihār.

In 1841, after Siddons had left the district, the Commissioner of Chittagong, Henry Ricketts[4], strongly advocated a detailed field survey on the large scale of 16 inches to a mile. He was definitely in advance of his time, and it was about thirty years later that this scale was adopted for the cadastral—or field by field—surveys that then became essential [8, 206, 214].

> It is my intention to recommend...that plans on a scale of about 5 chains to an inch, shewing every *dag*[5] should be made of several of the thanahs in the district. Such plans alone can be of any use to us, with property divided and subdivided as it is here. In thanah Putteah alone we have 40,000 proprietors paying direct to the Collector's treasury, and when the settlement shall be completed, I much fear we shall have 60,000. The litigation is endless, and till we have plans by which the courts can be guided, it must go on increasing.

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[1] from Rev Bd., 14–7–41 ; BRC. 3–8–41 (17). [2] Jungle Mahāls formed one unit along borders of Chota Nāgpur from 1802 till, in 1832, divided between Bānkura, w. Midnapore, and new dist. Mānbhūm [II, 19 ; III, 12]. [3] B to CD., Gen. Rev. 4–2–42 (11–5). [4] (1802–86) *DNB.* ; *DIB.* BCS. 1819 ; Orissa, 1827–38 ; Comnr. Chittagong 1841–8 ; KCSI., 1866. [5] field partition [III, 148].

Such maps will, of course, be a considerable expense, but it is far better to incur a large outlay on their preparation than to add to the strength of a judicial establishment, chiefly occupied in deciding cases unintelligible for want of plans[1]. ...

The Chittagong maps are all on too small a scale. Perfect for all geographical purposes, for revenue purposes they are next to useless. What we require here are plans shewing each field ; such plans as a person would have made of an estate previous to purchasing it ; such plans as are now made in England. ...

The scale there adopted is 10 chains to an inch. Our fields here being smaller, and the subdivision of property more minute, we must have a still larger scale. When the Cuttack operations were first undertaken, I recorded my opinion that the scale was too small. Further experience confirms that opinion. Not one of the 25,000 disputes now pending in this district can be decided by the aid of the village maps[2]. ...

For all revenue purposes the Chittagong maps are useless. A person travelling over the country may ascertain from them where he will meet with rivers, mountains and forests. The land under cultivation, and that of waste, is ascertained, but this is of very little practical utility. What we want here is the sort of plan a capitalist would call for before laying down his money for the purchase of an estate [289]. A person having very little scientific knowledge may be a most useful surveyor, or rather planner, and it is plans we require—not surveys—*plans*, by comparing which with the field any...attempts at fraudulent usurpation may be readily discovered. ...

The planning...must not precede the enquiries of the revenue officers. ... The revenue officers must decide to whom each field belongs, to Government or the talookdars, and, having decided, the field will without delay entered accordingly in the plan. ... In some places where there are few disputes the work will proceed quickly ; in others, where each acre will contested, the progress will be very slow. Village boundaries should be laid down [demarcated] by the revenue officers before these detailed operations are commenced upon[3].

Would a drawing of the moon's disk help us in describing the boundaries of countries and hundreds in that land ? In some places 3 chains to an inch will not be large enough to show the dags, and where the dags shall be very minute the scale must be increased so as to admit them. ... We have thousands of dag-to-dag cases. ... These...can be decided only on the spot ; either the judge must betake himself to the ground, or the ground must be brought by means of a plan to him.

I hope we may be able to reduce the expense. Native surveyors could do the work, which will require little science but, I...fear the temptation which would beset them, ... having neither... principles nor high salary to make them proof against corruption[4].

One great objection to cadastral plans was their ephemeral character ;

The field map which represents an estate one year, will never represent it fairly five years after. In fact we might almost as well attempt to map the waves of the ocean as field-map the face of any considerable area in any part of India. ... It constantly happens that beautiful maps become useless in four or five years[5].

In 1842, as a result of the wars against Afghānistān, there was an urgent call for retrenchment. Expenditure on revenue surveys had to be cut, both in the Lower and in the North-Western Provinces [229].

The following surveys, the immediate abandonment of which would involve a heavy sacrifice of expences already incurred, and the maintenance of which...is urgently recommended, will be prosecuted to a conclusion—Monghyr, a few months' work remaining—Midnapoor, two seasons work—Upper Assam (Luckimpoor), one season's work—Behar, work for a season and a half—Patna, work for half a season.

The Goalparah survey...will be abandoned. ... Work on the following surveys has...been completed, or is on the point of completion—Tipperah, already ordered for reduction—Balasore, Cuttack, Pooree, and Cachar, Muttock, field work finished ; office arrears to be completed by October or November. ...

The more active and useful of the officers...should be...transferred to the surveys which are to be continued, so that the completion of the latter may be accelerated, and the rest discharged with a gratuity[6].

The Board of Revenue deeply regretted the decision and declared the survey of the settled provinces a measure of absolute necessity, ... which, sooner or later must be carried through. ... Such a survey is not less necessary for the maintenance, in it's

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[1] DLR. 51, 10-3-51.

[2] ib. 15-3-41.

[3] from Ricketts, Chittagong, 17-5-41 ; BRC. 13-7-41 (27) DLR. 36/43 (118), 15-3-41.

[4] DLR. 51 ; 18-5 & 22-11-41.

[5] Sleeman (77-8).

[6] from Govt. of I., 30-9-42 ; BRC. 24-10-42 (16).

> integrity, of the permanent settlement, than was the survey of the North West Provinces for the equalization of the assessment of the unsettled districts. ...
>
> The gradual completion of the...settlement...is now placing at the disposal of the revenue authorities...a number of experienced officers, who could not be more usefully employed than on the boundary demarcation and other duties connected with the survey[1]. The Board cannot but repeat their regret that the state of the public resources should have prevented the continued employment of those trained parties on the survey of the settled districts of Bengal[2].

Of the settlement of revenues based on the Orissa surveys, the Commissioner of Cuttack commented in 1847 that the increase of revenue was

> inconsiderable, but neither was much augmentation expected, nor was this great work undertaken with the view to enhance the revenue. ... The important objects...were—to ascertain the area of each estate and the valuation of the land—to equalize the assessment, which had been fixed and augmented at hazard, ... and which pressed with much severity on many of the poor zemindars—to fix the boundaries of estates—to decide all disputes relating to them on the spot between landlords and tenants—to settle all questions of rights and tenures—to test the validity of the multitudinous rent-free tenures [185]. ...
>
> All this being done, ... each estate has been measured and surveyed, ... rents of each resident cultivator have been fixed. ... Operations which have conferred such permanent blessings on the people, and will be so beneficial...in a fiscal and judicial point of view, have not been dearly purchased[3] [229].

The importance of these revenue surveys could not indeed be ignored, and it was not long before the lower provinces had their regular survey parties and their Directors of Survey.

BIHĀR

The survey of Dāman-i-koh which had been for some time interrupted by Tanner's ill-health, was closed down at the end of 1832 [III, 137], and in January 1833 it was proposed that he should survey the *pargana* of Pharkaya in Monghyr District, to the north of the Ganges[4]. Monghyr had just been formed as a district by the transfer of several *parganas* from its neighbours, one of the largest being Pharkaya from Bhāgalpur. It was an area of swamp and jungle belonging to an ancient family, whose only revenue came from the grazing rights. Being waste lands classed as *wairāna*[5], they had been excluded from the permanent settlement, and Government now claimed possession owing to failure of the tenants to pay revenue[6].

After preliminary reconnaissance Tanner reported that he had found

> very extensive waste lands. ... The...villages...next the Gunduck River are all cultivated. ... The high grass and...wood jungal cannot be penetrated but by elephants. ... The several...mowzahs are...for the purpose of collecting rent for the thatching grass, firewood, and pasturage, and to measure such places with a chain or wheel will be impracticable.
>
> The most feasible method...will be to extend a series of angles over the extensive plains (and there are several large trees which will answer for...points by putting flags on them), and when the area is thus found, the several claims...can be first traced on a map, and afterwards marked off in the jungle by erecting mounds of earth at the corner of each portion[7].

Tanner could not undertake the survey, which was again called for two years later ;

> The original boundaries are wholly unknown, even by the oldest inhabitant, in consequence of these mehals having been out of cultivation from time immemorial. Without a revenue survey their identification is impracticable, ... and it is to be regretted that so much has been written—and so little progress...made—towards bringing these large tracts of waste lands into some train of management and improvement[8].

The Board of Revenue pressed for early action ;

> The local officers...strongly recommend a general survey, and agree...that facilities exist... for its prosecution, probably...without material opposition.
>
> The...land which might be at once held liable to assessment...appears...to be as much as 30,000 beeghas. ... As regards Furkeeah, the 14 tappahs of that purgannah are so intermingled

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[1] BRC. 24–10–42 (13). [2] ib. 17–5–43 ; from Rev Bd. 7–3–43. [3] Comnr. 23–1–47. [4] *v. Bengal Atlas*, II, spaced name **FURKYAH** ; cf. Sherwill. [5] a deserted place. [6] O' Malley (163, 252–3) ; *Imp Gaz.* XVII (393). [7] from Tanner, Gangaur, 2–2–33 ; BRC. 6–10–35 (20). [8] ib. ; from Dep. Collr. 1–4–35 & Comnr ; 18–4–35.

> with each other, and with wyranee land, ... that a separate measurement of any portion distinct from the rest will not easily be practicable. ... The first object...is...possession in a permanent manner, as the survey advances, of the tracts of land yet unoccupied. ...
>
> The Board will require...with the least delay possible...the records of a few cases which, with the maps of the surveyor, will shew...the right of Government to resume portions of the cultivated land, ... so as to encourage...fair and amicable compromise by the proprietors of neighbouring estates. Where disputed questions regarding boundaries are to be decided... recourse may be had...to arbitration or an award by a punchayut[1]. ...
>
> The survey...must...be scientific survey by a competent officer. ... An officer vested with full powers...should accompany the surveyor...for the possession and management of the undisputed land, for adjusting the boundaries, and arranging for the settlement of lands... already decreed in favour of Government, and for the adjudication of...land in dispute.
>
> The Board...recommend the immediate appointment of a surveyor and establishment to... form a survey of the whole of the lands...exhibiting distinctly;
>
> First.—The undisputed...tracts...which are acknowledged...to be liable to assessment.
>
> Second.—Lands and boundaries disputed, or claimed by the parties concerned...as belonging to assessed villages, or to waste villages having proprietors, or to waste villages of which the proprietory right has devolved to Government from the absence of individual maliks.
>
> Third.—Tuppahs and mouzahs, with their chauks, ... already assessed.

John Egerton, of the Artillery, was appointed Surveyor from 22nd December 1835, and reported a few months later that the greater part of the estates

> consists of cultivation interspersed in the grass jungle in such an intricate way as to render a perfect survey...an undertaking requiring more time...than...the object would be worth. ... I would strongly recommend that the survey shall be strictly a geographical one. I am accordingly laying down the boundaries of each mouzah, with sites of the villages, all rivers, nuddies, roads, jheels, and principal features. ...
>
> By the method I pursue no error in any single [circuit] is communicated to its neighbour. I can also immediately detect any error, and the amount of it, so that I can trust Mr. Wilson [189–90, 198] without fear in his independent operations.
>
> My establishment will stand as follows:—Rupees 222;
>
> One English Writer, Rs. 30—One Moonshee, Rs. 20—Two Native Surveyors, Rs. 40—Two Tindals, Rs. 12—Eight Classies, @ Rs. 5;—Twelve Classies @ Rs. 4, 88—Four Bildars, Rs. 16—Four extra Classies in case of sickness, or when in thick jungle, Rs. 16.
>
> I shall further reduce this expenditure by discharging, when I am not in camp, classies to the amount of 64 rupees or more. I cannot do without the English writer as my assistant will be so much employed in other matters[2].

As survey was much hindered by dense undergrowth that was practically impenetrable before the middle of April, Egerton found work in Bhāgalpur District till then. His survey was carried out in close co-operation with the settlement officer, Drummond[3], and report was made to the Directors in 1838 that

> 97 mehals are now ready for settlement as soon as the necessary data are supplied by the Surveyor. Mr. Drummond is checked...on account of the survey. The difficulties appear to be that the accurate measurements of the Surveyor are necessary to test the returns of the aumeens, ... and the recent orders preclude resumption till the existence of the land is determined by actual measurement. ...
>
> The exertions both of Mr. Drummond and of Lieutt. Egerton are highly and justly commended. ... No less than 251,956 acres have been measured during the past season, of which 169,421 have been already settled, and 82,535 are either resumed, or will shortly be so. About 40,000 acres in the midst of the pergunnah remain to be surveyed, besides 20 wyerana mehals on the east side, probably as many acres more. ...
>
> The pergunnah even now nearly...defrays the annual expense of the present operations, and in a few years...the revenue will be nearly doubled, and the country, instead of a mass of uninhabited jungle, will present the appearance of a rich and thickly populated district[4].

At the end of 1837 Egerton was transferred to Hijli [186, 188–9], leaving George Ellis, also of the Artillery, who had early in the year been posted to Monghyr for the survey of *parganas* south of the Ganges[5]. Ellis complained

> of great detention from boundary disputes and...[lack of] powers necessary to ensure their

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[1] *panchayat*=village court. [2] from Egerton, 2–3–36; BRC. 26–4–36 (41). [3] Hon. Edmund Drummond, BCS. 1831; Mgte. Bihār, 1829; Dep Collr. Monghyr, 1839. [4] B to CD. Gen., 13–10–38 (101–3). [5] Rajgir and Amarthoo, printed maps, MRIO. Misc. 13–O–46.

> prompt and regular settlement. His progress is at present very slow indeed, not exceeding ...six square miles per mensem. ... The average cost of his work is...extravagantly high, vizt., about 240 rupees per square mile, while that of Lieutt. Egerton does not exceed 45 rupees[1].

He was constantly moving between Monghyr and Bhāgalpur, completing

> the survey of Rajgeer...on the 15th December 1838. Being then out of work he returned to Monghyr, and on receipt of order for a proposed survey in Bhagalpore he proceeded to that district, and during the remainder of the season completed the pergunnahs of Kuzrah and Kuru Khoor, excepting a few scattered villages and a jungle tract, which the general sickness of his party and the early commencement of the rains obliged him to leave undone. ...
>
> He was detained at Monghyr and kept without field employment for about one month and a half during the best season of the year, ... by which means, and the unusually early commencement of the rains, his actual time of survey was reduced to about four months. The lands under survey were also much detached. ...
>
> The unhealthiness of the jungle tract...laid up his assistants with such serious fever that all four of them were...on medical certificate during the recess. ...
>
> Captain Ellis's aumeens furnish a neat field plan, which no others do in these provinces, except at Jynteeah [207].
>
> As soon after the rains as the jungle tract could be entered in safety, Captain Ellis took the field, and soon completed what remained. ... He then returned to Monghyr, and has there been waiting some time for orders to move down to Rajmahal, where the survey of some resumed pergunnahs has been proposed[2].

Even more time was lost during season 1839–40 and actual field work did not exceed nine weeks altogether. The Board of Revenue commented severely on the waste of time and expense which they attributed to lack of co-operation

> between the Surveyor and the Superintendent of the Khass Mahals. Capt. Ellis appears never to have received the requisite instructions from the revenue authorities. ... It is no wonder that a survey so conducted should prove to be imperfect and incomplete[3].

In October 1840 Ellis was ordered to Assam, and the establishment took up the survey of "the resumed jageer of the late Rajah Gujraj Singh" in Rājmahāl, and "the detail measurement...of the great havellee Purneah estate...at the expence of the proprietors". These surveys passed in succession to assistant surveyors Robert Shaw, O'Donel, and Fitzpatrick, till completion in 1844.

Towards the end of 1841 two parties under Stephen and Maxwell from the western provinces took up survey of the districts of Bihār and Patna [229][4].

> The expediency of surveying these districts...had been some time ago urged, ... and the work was authorized last season on the occasion of two highly efficient parties which had before been employed in the N.W. Provinces, being placed at the disposal of the Bengal Government. ... Some time was lost in arranging preliminaries, and in marking off the village boundaries, ... and indeed the season was somewhat advanced before the Behar party could leave the scene of it's former labors in Bundelkund[5].

Stephen started work in February 1842, but on being ordered to join his military unit in April handed over "the Persian office and comparison of kusrahs and...professional [survey] with thakbust plans [205, 233] to Mr. Dodsworth, and the professional...work...to Mr. Pemberton". Walter Sherwill took charge from 13th June, and held charge till Stephen's return a year later. He reports from Gaya that during season 1842–3 the party surveyed 2,293 square miles ;

> Had it not been for the large scale upon which the greater part of the work has been constructed, and for the large tract of dense forest and hilly country...through which the lines of several pergunnahs...had to be forced, ... the area surveyed would have been much larger[6].

A very full map of "South Behar" is preserved, covering that country to the south and east of the Son River, from the west of Rohtasgarh to the border of Ghidhor—in colour, with minute lettering—surveyed by Stephen and Sherwill 1842 to 1845, scale 4 miles to an inch, reduced from the one-inch scale[7].

Meanwhile Maxwell's party had started in Patna District at the end of 1841, and though formed in an extended scale for the annual survey of 3,000 square miles [216–7],

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[1] from Bedford, Calcutta, 12–1–38 ; BRC. 12–6–38 (144). [2] from DSG. 13–1–40 ; BRC. 31–3–40 (3). [3] Rev Bd. to Comnr. Bhāgalpur, 19–8–40 ; BRC. 30–3–41 (6). [4] 1865, Bihār Dist. broken up ; Bihār Khās tr. to Patna, remainder becoming Gaya Dist. [5] from Rev Bd., BRC. 24–10–42 (13). [6] DLR. 37/82 (180), 24–11–43. [7] MBIO. 56 (25, 56) ; Misc. 6–O–44 ; *IO Cat.* (185).

> so much time was lost at the commencement of 1841–42 that 805¾ square miles only were completed. ... The sudden call moreover for the military services of Lieutt. Maxwell with the Army of Reserve also interfered...when charge was made over to Mr. Asstt. Bridge [July 1842]. ... Lieutt. Thuillier proceeded last month to assume charge of this party, and although detained for some time at Rampore Bauleah in expectation of a steamer, has doubtless ere this arrived at Patna[1].

Thuillier's transfer all the way from Sylhet was ordered "as being a less evil than that of leaving the large establishment at Patna without an efficient head"[2]. He did not reach Patna till 11th December, and held charge less than two months before Maxwell rejoined. The Commissioner pressed for speed ;

> I trust that no consideration of economy will induce Government to arrest the progress... now that it has advanced so near to it's completion. There is no district...in which a survey was more required, owing to the great intermixture of the lands of different estates. A scientific survey of the dearahs[3] on both sides of the Ganges, and of the islands in the middle of the river—the determination of the boundaries between the Tirhoot and Patna districts—and the final adjustment of the numerous long-pending disputes now existing—are objects of such importance both to Government and the community that the sudden abolition of the survey could not be considered otherwise than a public misfortune[4].

The survey was completed during 1843 and Maxwell then moved the party into Sāran District[5].

ORISSA, 1837–43

In 1833 an attempt was made to resume the revenue survey of Cuttack District that had been started in an experimental way by Buxton in 1821 [III, 136–7].

> Mr. Wilkinson[6] measured and settled the large Khoordah Estate, and Mr. Ricketts followed the same course in 1834...in Balasore [187], but no systematic measures appear to have been adopted to rectify the long-acknowledged defects of the revenue system...till 1836, when survey and settlement operations were commenced in earnest. ...
>
> The measurement was in the first instance entrusted to the Collectors, but...Government... wisely determined to precede the assessment by a scientific survey defining the area of villages and their boundaries, and showing the total amount of cultivated, culturable, and barren lands, the sites of rivers, embankments, groves, roads, houses, jheels, and other objects, ... and to place the control of...professional and khusra surveys...under experienced officers.
>
> Deputy Collectors were appointed to each zillah for...demarking boundaries preparatory to the survey, and deciding the boundary disputes. ... When the survey and measurements of the season were concluded and tested, the maps and papers were sent to the Collector, and that officer distributed the tract...amongst the Settlement...Deputy Collectors[7].

A particular feature of Cuttack was the number of "petty rent-free tenures [*lakherāj*]...which are known to be exceedingly numerous, and most of which are assumed to be liable to resumption".

> The mapping of the estates of Cuttack...to shew the three-hundred-thousand lakheraj... tenures will be a work of inconceivable minuteness, and the expense of the survey unquestionably depends on the number of lines to be measured accurately by the chain. The ameens, or interior surveyors, both in the Western Provinces and Chittagong, shew every field in every village. They will do so in Cuttack. ...
>
> The expense of the proposed operations...will doubtless be considerable, amounting, perhaps, ... to two lacs of rupees per annum, or ten lacs in the aggregate. But...the only alternative...is the entire abandonment without investigation of the public demand upon lands which...probably yield a rental of not less than twenty-five lacs of rupees per annum. ...
>
> His Lordship...would commence the survey...at the commencement of the approaching cold weather [1837–8]. ... The first season may be regarded as experimental. If the results be found to be so unfavourable...as not to warrant the further prosecution, ... an issue which the Governor by no means anticipates, it will then be time to submit to the heavy sacrifice of revenue which that issue will involve[8] [8].

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[1] from DSG. 20–12–42 ; BRC. 17–5–43 (4). [2] BRC. 17–2–43 (40). [3] sandbanks. [4] from Comnr. Patna, 19–8–42 ; BRC. 7–11–42 (41). [5] MRIO. 56 (26, 46–7), Patna Dist. ; Maxwell, 1842–3 ; 4 m. to inch ; cf. MRIO. Misc. 90–O–64, with interior boundaries, 1863–4. [6] Wm. Wilkinson, BCS. 1813 ; Collr., S. Div. Cuttack, Oct. 1828 ; Mgte. Central Div. 1842. [7] from Comnr., Cuttack, 23–1–47 ; *Ben. Sel.* 1908. [8] from Sec. to G of I (Rev.). 1–8–37 BRC. 22–8–37.

John Fraser, of Engineers, was appointed to charge of the survey with a separate party for each of the three districts, Puri, Cuttack, and Balasore.

> It is his Lordship's intention to appoint military officers as subordinate surveyors under your orders to the districts of northern and southern Cuttack and, if possible, to Hidgellee[1].
>
> You are...to place yourself in constant communication with Mr. Commissioner Ricketts and the Survey Committee at the Presidency[2] [180 n.4, 297–302], through whom you will submit...a report of the establishments necessary...for yourself and each of your assistants. ...
>
> Captain Bedford will...through the Lt. Governor of the N.W. Provinces, place at your disposal as many junior uncovenanted assistants as can be spared from that quarter[3] [393].

Jasper Trower was posted to the southern, or Puri, division from 3rd October, Ralph Smyth to the central, or Cuttack, division from 20th November, and John Fitzpatrick from the western provinces took charge of the Balasore survey from January 1838. Egerton and Mathison started separate surveys in Hijli[4] and Midnapore during 1838. In March 1838, before work had got really started, Fraser took leave on medical certificate, and the three assistants surveyors came under the direct orders of Bedford at Calcutta. Each party was allowed one senior, and three other, sub-assistants, European or country-born, with sufficient *amīns* or surveyors, for both professional and *khasrah* surveys.

The *khasrah* survey of nine *parganas* of Puri District had been already completed by the Collector, leaving eleven for the Surveyor. In those *parganas* that fell under the permanent settlement no details of cultivation, waste, etc., were recorded, and work was confined to village and estate boundaries, and to geographical features. The unsettled *parganas* were surveyed in full detail[5] [180].

Trower's progress was not so good as in the other districts, "owing partly to his indifferent health, and partly to mismanagement and a want of proper concert with the revenue authorities". He had trouble with two of his assistants, and for want of having boundaries settled in advance lost several weeks without work. He had to take leave on medical certificate in August 1839, handing over charge to his senior assistant Robert Shaw who managed the party most successfully until the arrival of Thuillier in April 1840 [200];

> During the recess he instructed his native surveyors, as did also Lieutt. Smyth, in the use of the surveying board, a modified description of plane table [211], light and well-adapted for minute interior details, and during the months of November and December he completed the survey of about 100 square miles in addition to the revision of 130 villages of Lieutt. Trower's survey of 1838–39, in which the professional and khusreh results did not properly agree[6].

The civil authorities had made better arrangements for season 1939–40 ;

> The Collectors have all visited the pergunnahs under survey, and are using their most strenuous endeavours to accelerate the demarcation of boundaries ahead of the survey, but... the survey is more efficient than it had hitherto been, and is making greater progress[7].

After giving special praise for Shaw's "active zeal and judicious arrangements from the time he took charge in the rains of 1839 to the 10th April 1840", Bedford commends the sound work of Henry Thuillier ;

> The remaining portion of the Pooree division...was completed during 1840–41. ... The usual professional interior and khusrah details were excluded from the whole...except Rahung, ... and only those of a geographical nature exhibited. ... About 1,682 square miles were thus professionally surveyed in about 65 circuits only, instead of...in 1,500 or 1,600.
>
> The survey of Killah Bankee...was deferred...and will form part of Lieutt. Smyth's operations of 1841–42. ... The Pooree Division being completed, ... Lieutt. Thuillier's party was transferred during the recess of 1841 to Cachar [200][8].

Thuillier's survey ran to the southern borders of Orissa and

> the survey of the western bank of the Chilka Lake being very essential...I obtained the sanction of the Ganjam civil authority before entering his jurisdiction. I was unable to obtain exactly what portion of the lake belonged to the southern provinces, indeed a distinction of property cannot be but imaginary in such an expanse of water [III, 19][9].

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[1] coastal area of Midnapore [1 : 50 n.7]. [2] Bedford had not at this time arrived at Calcutta as Supt. Rev. Svys. [3] from Sec. Rev. Dept. 12–9–37 ; BRC. 12–8–38 (70). [4] Hijli, Salt Agency, coastal strip SW. from Kedgree. [5] DLR. 37/60 (7), Oct. 1841. [6] Report by DSG. ; BRC. 31–3–40 (2) ; para 58. [7] from Comnr. Cuttack, 22–1–40 ; BRC. 8–9–40 (72). [8] Report by DSG. ; BRC. 3–6–42 ; maps MRIO. 56 (43) Puri Dist. ; 133 (48), Ganjam & Orissa, with rev. svy. of Puri. [9] DLR. 36/7 (51), Thuillier to DSG., 18–10–41.

In Cuttack District, the "central division", Smyth had difficulties from

> the non-attendance of the zemindars and the persons to point out the boundaries, ... by which much extra labour...and delay were occasioned [178–9, 189].
>
> In the next place, the services of Lieutt. Smyth's most efficient assistant (Mr. Turner) were...put in requisition by the Commissioner of the 24-Parganas for some survey in the Sundarbuns, and...that individual suddently quitted his post in the middle of the survey season, leaving his work unfinished, and thereby causing great confusion and trouble.
>
> The proceedings...were further delayed...by the idle and insubordinate conduct of Lieutenant Smyth's other assistants. ... Add to which, effective arrangements had not been matured for the settlement of boundaries ahead[1] [186].

Progress improved greatly in later seasons and, writes the Commissioner,

> Lieutt. Smyth calculates that he can survey 70,000 acres every month. To settle the boundary disputes of the alienated lands...in 70,000 acres would employ...6 Deputy Collectors.
>
> I went to the Surveyor's camp in company with the Collector in the early part of last month. Finding that the work was not progressing sufficiently quick, I took upon myself to depute Mr....Hough[2], making 3 Deputies employed in boundary duty. ... The survey is still ahead, and the Collector is now in the mofussil doing what he can to expedite the work. ...
>
> The Dy. Collectors...work as hard as they can, and I have desired the Collector to stop the survey for the present season after the completion of parganas Songra and Matkudnuggar, unless he can provide an area with clearly defined boundaries. ... It is far better that the latter establishment should be discharged...than kept on without work[3] [184, 237–8].

At the end of 1841 the Commissioner obtained sanction for the survey of the Killa Bankee *mahāl*, though his proposal to extend it to the rest of the Tributary States was not accepted ;

> As the survey of the Cuttack District will be...completed by the end of March, I propose... surveying the tributary muhal, Killah Bankee, which has become the property of the State. The Surveyor will have no difficulty in finishing this work within the season.
>
> This appears to me a fitting opportunity for...extending the survey to the whole of the jungly tract held by the Tributary Rajahs, stretching...west as far as Boad, and from Singbhoom, ... north, to Goomsur in Ganjam, south.
>
> I do not imagine that the Rajahs themselves would throw any obstacles...in the way. ... We at present know almost literally nothing of these regions. There is not a correct map of the country and, were disturbances to break out tomorrow in Keonjoor, Angool, and some of the adjoining Killahs, I should have to depend on native information alone as regards the roads and passes leading into them [1 : 80].
>
> There is not a record in this office which throws any light on the subject. ... Boundary feuds are not uncommon amongst the Tributary Rajahs. The boundaries of each...should be defined. ... I would, therefore, recommend that the Surveyor be appointed an Assistant to the Superintendent, which would empower him to settle these disputes at once[4] [179].

Early in 1842 Bedford reported that by the end of the season Smyth's party

> will complete the unsurveyed portion of his division...together with the detailed survey and measurement of the tributary muhal, Killah Bankee. ... But for this last...Lieutt. Smyth would have been able to commerce on the buttwarah survey of the Mundleghaut estate in District Hooghly[5]. This, however, has now been...postponed until after the rains of 1842[6].

The move to Hooghly District was not made, for Smyth's party was amongst those broken up at the end of 1842. He now took furlough, having established himself as a surveyor and organizer of unusual ability [pl. 10].

Fitzpatrick's start in the northern division, Balasore, was more successful than the others, and the Collector "appears throughout to have given the survey his most cordial aid". During season 1839–40 outturn was further increased, and cost-rate of the combined professional and *khasrah* surveys reduced ;

> The progress of my survey was not hindered much by boundary disputes in the beginning of the season, but in the months of March and April considerable delay was experienced, and in May two square miles were only done, after which there was not a single village of any other purgannah ready. ... I was obliged...to suspend boundary operations, and to set all parties in bringing up the details, which I was able to effect by the end of May.

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[1] Report from DSG. paras 46–8 ; BRC. 31–3–40 (3). [2] G. Hough, Dep. Collr., Cuttack, 12–9–37 ; *Ben Dir & AR*. 1840 III (72). [3] from Comnr. 17–3–40 ; BRC. 8–9–40 (72). [4] from Comnr. 2–11–41 ; BRC. 16–11–41 (13). [5] *batwara* = division of estate among co-owners for revenue purposes. [6] BRC. 13–6–42 (6) & 1–8–42 (32); map, Cuttack Dist. MRIO. 56 (14).

> Two causes contributed much to interrupt the interior parties. The principal was the difficulty of the details in the villages. ... Every field, however, minute, which was distinctly marked, was surveyed and noted in the map. The other cause was the cholera, the fear of which...operated so powerfully...that for several days all work was suspended, or very languidly carried on. I reported several deaths, amongst others that of two smart mootsuddies, which crippled much the progress of that branch of the survey.
>
> The khasreh measurements...have been conducted with great accuracy, ... principally owing to the strictness exercised by the purtall ameens. At the commencement several villages were examined and found incorrect, in which case the purtall aumeens had orders to seize immediately the papers...of the aumeens who measured the village, as also those that belonged to the man sent on the part of the zemindar, and to forward both to me. Such a method left no chance to the ameen to copy the old work, and he was, therefore, obliged to go over the whole. This I found had the desired effect, and ameens became more careful[1].

During season 1840–1, Fitzpatrick

> completed the pergunnahs of Sumnant and Byang, and his parties are now proceeding with the remaining southern pergunnahs. ... The whole of these are expected to be surveyed by the end of season 1840–41, together with some lands belonging to the Kunkah Rajah. ... Mr. Fitzpatrick will then proceed northward to the neighbourhood of Balasore, and...endeavour to effect a satisfactory junction with one or more of Captain Boileau's stations of the Purusnauth series, ... by means of which the positions of the principal places...may ultimately be deduced from those of the Great Trigonometrical Survey [60, 233][2].

The Balasore survey was closed in October 1842[3], and Fitzpatrick transferred to charge of the Rājmahāl and Purnea survey [184].

MIDNAPORE, 1838–43

Midnapore District, of which Hijli was a subdivision[4], had come under the permanent settlement, but was now officially part of Orissa, and administered by the Commissioner of Cuttack. When Mathison was posted to the survey in April 1838 the Commissioner advised him to take up work "close to the station of Midnapore" rather than in Hijli, which should wait till the following December—"to send a surveying establishment into Hijelee at this season is useless—in 15 days there would not be a man fit for duty"[5] [186 n.1, 403].

No boundaries had been cleared in advance, and the Collector had to apply for a special staff of Deputy Collectors, his own staff being already overworked. Mathison therefore spent his first months in the higher ground of the headquarters *pargana*, taking the opportunity of training his newly recruited establishment. The Commissioner directed that the *parganas* of Midnapoor and Burraboom

> should be surveyed, measured, and settled. Whether you will eventually have the charge of this survey or, as was originally intended, have the survey of Hijellee, I cannot say. I have recommended that you should be appointed to Midnapoor, and another surveyor and party appointed at the commencement of the cold season to Hijellee. ...
>
> The mornings in this part of the country are nearly always fine. We have not had *one* wet morning this year yet, and in high lands, such as those in the neighbourhood of Midnapoor, considerable progress may be made even in this season[6].

Mathison reported to the Deputy Surveyor General that he had

> seized every opportunity between the showers, ... instructing the establishment by traversing one or two neighbouring compounds. I have...entertained 3 native lads for the professional survey, and 10 clashies with whom I...commenced upon the boundary of the station. ...
>
> Since the 16th my establishment have been daily employed, when the weather permitted, upon the boundary and interior survey of the station of Midnapoor. In consequence of almost daily rain, and having been of late deprived of the services of my assistant Mr. [C] Blaney by sickness, but little progress has been made[7].

He reports to the Collector on 10th August that "after having completed the survey of the station and cantonments, ... which I hope will be in a few days, I propose commencing the measurement of the lands belonging to, and adjoining, the city", and on 1st December he reported that "the measurement of the lands near Midnapoor is now nearly completed, and I hope to commence a main circuit"[1].

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[1] from Fitzpatrick, 6–12–40 ; BRC. 30–3–41 (7). [2] Report from Bedford, para 40 ; BRC. 30–3–41 (7). [3] MRIO. 55 (7–11) ; Balasore Dist. [4] MRIO. 42 (4, 6) ; Hijli by Robt. J. Rose [III, 19]. [5] from Comnr. 23–4–38 ; BRC. 12–6–38 (215). [6] DLR. 37/46 (33), 5–7–38. [7] ib (37, 47) 16–7 & 1–8–38.

By November the Collector had obtained the staff necessary to settle and demarcate the boundaries, and Mathison obtained instructions for the *khasrah* survey ;

> Lands surveyed to be classified ;—1st. All cultivated...at time of settlement.—2nd. Fallow, and lately in cultivation—3rd. Culturable waste, no signs of having at any time been under the plough—4th. Unculturable waste, will never...be cultivated.
>
> The Revenue Board have determined that the native measurement should be made by contract, and that the aumeens employed under the Surveyor shall contract for the preparation of only such part of the field book as is immediately connected with the measurement. ...
>
> The *chitta* [written record]—the first 5 columns being connected with the survey contract with the Surveyor, columns 6 and 7 relate to the settlement, also column 8, the assessment.
>
> The introduction of field maps is directed, ... prepared by the Surveyor's aumeens[2].

Whilst Mathison now made a start with his programme for season 1838–9, Egerton from Bihār [183] was posted to charge of the survey of Hijli[3], on which he made a start in January 1839, having

> all the arrangements of a new survey to make, and to conduct it amidst very serious obstacles in a jungle district infested with wild beasts, and closed for some time after any heavy fall of rain. He had also to combine therewith the khusruh measurements which at Furkya were under the Collector's superintendence [183], and experienced, in common with all the neighbouring surveys, great difficulty in procuring contracting aumeens on moderate terms [170, 190]. Hijellee, moreover, is notoriously unhealthy, and all classes of the survey establishment suffered most severely. Lieutt. Egerton himself, ... after several attacks, was at length compelled to proceed to England[4].
>
> After the departure of Lieutenant Egerton [Aug. 1839] the Hijellee survey was combined with that of Midnapoor under Lieutt. Mathison, who in addition to his own work...has very zealously exerted himself in bringing up the heavy office arrears caused by Lieutt. Egerton's sudden departure, and the continued sickness of his establishment.

During 1838–9 Mathison worked in the Midnapore *pargana* ;

> The area surveyed...was 380 square miles. Except for 1 European officer and 4 native surveyors from other surveys, the whole of the establishment was new and untaught. ... Of the district surveyed more than half is a dense saul jungle [220 n.9] and...a forest tract requires much additional labour in the clearance of lines and area calculations, which are... multiplied by the necessity for having short lines.
>
> The country is also greatly infested with elephants and bears, and the native surveyors with their parties are very unwilling to commence work before a certain time of the day.
>
> But the chief interruption...is the difficulty...of securing the attendance of mookhtiars and other village authorities to point out boundaries. Parties have repeatedly returned to camp without work, having waited...the whole day for these people, and I have myself...been compelled to leave off work for the day in consequence of their non-attendance [179, 187]. ...
>
> As long as the field operations lasted, the whole of my time from sunrise to sunset, and often later, was daily devoted to the superintendence of the survey. ... There is necessarily a great deal of exposure ; the climate...renders such exposure highly dangerous. During the latter part of the season a number of my people were daily seized with fever, and on my last main circuit my head ameen and a khalasi, out of about 12 persons with me, died of jungle fever.

Though, like other revenue surveyors, he was invested with magisterial powers, these did not avail much in compelling attendance of the local people. He "had not the time to assume the duties of a kutchery, and to prosecute and fine offenders"[5].

The following year he had to explain and put right a number of discrepancies which the Settlement Officer of Hijli found in the *khasrah* records ;

> Long before the end of the field season [1838–9] Mr. Egerton, his senior assistant, and most of his native surveyors were laid up. Many of these latter went to their houses, ... and some never returned. ... Mr. Egerton was scarcely able to attend to the accounts up to the day he embarked for England, and the whole task devolved upon the senior assistant, Mr. Wilson, who was previously obliged to leave Hijilee long before the conclusion of the work.

---

[1] DLR. 37/47, (30); plan of Midnapoor cants., sd. Mathison ; long. 87° 18′ E. by J.'s satellites ; lat. 22° 26′ 05″ N. by Sirius, Aldebaran, Capella ; place of obsn. Bungalow Z., 9–11–38. [2] ib. 37/46 (39), 12–7–38. [3] Hijli, salt agency till assigned to Midnapore, 1836. [4] Report from Bedford, 13–1–40 ; paras 36–8 ; BRC. 11–3–40 (77). [5] DLR. 37/46 (142–60), to DSG. 8–7–39 ; 19–2–40.

Egerton had retreated to Dum Dum for the rains, and it was there that Wilson had struggled with the Hijli papers, and finished off the Pharkaya maps [183]. He took the field again at the end of September. Mathison found it hard to check up Egerton's work, especially in the forest area, and the Settlement Officer asked

> to have all these villages marked off, and their locality made known to me. It would then be necessary for competent persons...to show the boundaries, otherwise...how they would be ascertained, unless tigers and buffaloes (the only inhabitants) are vested with the powers... of amin mookhyas[1]? ... Between the east boundary and the Surple River is a dense jungle infested with buffaloes and other wild animals, so that the surveyors could not enter. It was triangulated by Lieutt. Egerton in person, and the course of the river, etc., sketched[2].

The Settlement Officer knew his district well, and warned Mathison before the opening of the field season that "Nothing has yet been done in the way of laying down boundaries for the survey. It would...be useless to send an officer down to Hidgelee just now. He would require to be *web-footed*"[3].

A suggestion was made that the *khasrah* survey should be transferred to the Collector, but he would have none of it ;

> Lieut. Mathison has surveyed one lac and thirteen thousand acres without having boundaries of estates or villages systematically laid down by the Collector, ... sufficient proof of the feasibility of surveying...without the expense of an establishment under the Collector. ...
>
> Now the following reasons occur to me why the maps ought not to be prepared by amins under the...Collector, but by the Surveyor.
>
> 1st. My total ignorance of everything relating to the making of maps and surveys, and my want of time to make myself acquainted with the subjects.
>
> 2nd. The worthlessness of the best maps that common Bengalee ameens have ever made. I refer to Mr. Bruce's[4] maps of...Mysadul. The ameen who prepared these maps received 15 or 20 rupees per month, exactly the same salary that native surveyors can be engaged for.
>
> 3rd. The impossibility of immediately procuring a sufficient number of aumeens capable of making the likeness of a map.
>
> 4th. The fallacy of expecting to survey and map better and more easily through the agency of ignorant and inexpert men, where even educated and scientific men experience difficulty. ...
>
> A khusrah measurement falls short of what is required. ... A map showing every estate on the Towjee is...required, and...nothing less should be accepted. The chitta of a khasrah measurement will certainly be much more useful than maps made by common aumeens.

Mathison contended that though he did manage "without a Deputy Collector's aid, ... the result has proved that work would progress far more rapidly with a previous demarcation". A conference was called and the Commissioner ruled that "the boundaries should be settled beforehand by a Deputy Collector, and ...the survey of the fields...carried out by ameens working under the Surveyor"[5].

During 1842 discrepancies were reported along the junction of the Midnapore survey with Fitzpatrick's work in Balasore, and Mathison was called upon

> to examine the pergunnahs. ... I shall be greatly astonished if my accounts are wrong, for I see the calculations are my own. ... They played me a similar trick last year by disputing the size of my beegahs, and sent a memo of calculations including *barleycorns*[6] which my poor decimals of an inch had to be turned into. The Collector now brought out his calculations of areas to yards, but where he found such an item, God knows ! It is no joke having to do these things twice over because karanees[7] and Deputy Collectors do not agree with me.

He grumbled at having to plot on the 8-inch scale ;

> I wish this large scale...was at Jericho. It is four times the work of the former scale, and the Revenue Board now take *rougher* work. Neatness is not to be had.
>
> Messrs. Lane & Watson[8] have met at the junction of the two surveys, and this 2nd revision shows a result similar to that communicated. ... Mr. Lane, finding such an enormous difference, carried across the circuit two other series of angles, and the accounts by each of these brought out precisely the same bearing as by the route of Mr. Fitzpatrick's stations. ... It is a matter of total indifference to me whether Mr. Fitzpatrick's operations are right or wrong, ... my object being to show the correctness of my own work, and this I submit I have done[9].

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[1] DLR. 37/47 (17), 6–6–40.
[2] ib. (25) ; to DSG. 31–7–40.
[3] ib. 8–11–40.
[4] Thos. Bruce, BCS., 1826.
[5] DLR. 37/47 (155–67), 6/23–6–41.
[6] 1 *hat*=1 cubit, about 18 inches ; 1 *balisht*=1 span, about 8 inches=12 *angul*, or width of finger ; 1 *angul*=8 *jau*, width of barley-corn ; 1 *jau*=6 mustard seeds.
[7] *karāni* = writer.
[8] Wm. Lane, sub-asst. from Midnapore ; F. C. Watson from Balasore.
[9] DLR. 37/48 (34, 43), 7/11–5–42.

Bedford found "overhaste and want of due care are clearly established against Mr. Watson", and the Commissioner then recommended that "a small purtalling establishment be placed under a Deputy Collector" deputed to check all the records on the ground. Mathison resented this proposal that his work should be checked by a non-professional officer, and recommended that "in future operations, the khusrah be abolished in toto, and that everything be laid down by survey". He had to admit "a serious charge...made against...one of the senior sub-assistants. ... The traverse book gives 281 acres, but the Collector's map has 681, and so also has my area notebook in my own handwriting[1]".

In February 1842 Mathison was recalled for military duty, but the orders were cancelled after protests from Bedford and the Board of Revenue;

> The sudden removal of Lieutt. Mathison...will...occasion very great embarrassment. The state of landed property at Midnapore is peculiar. ... Lieutt. Mathison has been now employed some years in the district, and the local knowledge which he has acquired, as well as his active, energetic, character, qualify him better...than, perhaps, any other officer who could be appointed. Moreover there is at present no assistant available who...could be entrusted, even temporarily, with charge of the survey[2].

Whilst other surveys were to be closed down at the end of 1842 the Midnapore survey was one of the few ordered to "be prosecuted to a conclusion" [181].

> Lieutenant Egerton was...appointed to survey the temporarily settled mahals in the Hidgellee division...preparatory to a revision of the assessment. ... Another party was formed... under Lieutenant Mathison for the survey of the large mehals in Midnapoor which had been purchased on account of Government [177, 179]. ...
>
> In the next season the parties were consolidated under Lieutenant Mathison who, after finishing the unsettled mehals in Hijellee, suggested...completing the map of that division... by the geographical survey of the intermixed settled estates. This was sanctioned, and it was ordered that the survey should include also a demarcation of the boundaries of estates. ... Extending the survey to the whole Midnapoor District was...eventually sanctioned. ...
>
> The surveyed area amounts now to 2,575 square miles, ... leaving for survey an area of 1,660 square miles. Of this remaining area about 650 square miles...might be surveyed topographically, without...village boundaries. ... In the other pergunnahs...the village boundaries have already been laid down at a considerable expence by the revenue authorities. The remaining work may...occupy nearly two more seasons, at a cost of about 50,000 rupees. ...
>
> There is, besides, a large tract...in the western part of the district called the Jungle Mehals [180 n.2], comprising perhaps 2,000 square miles, which it has been determined to survey geographically, merely defining the pergunnah (or mehal) boundaries[3].

In spite of Mathison's confidence in his professional survey, it did not always conform to the true limits and areas of the estates and village lands, nor had he been able to ensure that the *khasrah* measurements of the *amīns* working under his orders agreed either with his professional survey or the true boundaries. Of some village areas he reports his belief "that in many of them there is a determination to conceal lands. ... They are all far short of the real areas"[4] [177].

Mathison handed over to Wilson in 1844 and on his return from furlough reverted to regimental duty.

Many errors and discrepancies were shewn up during the settlement operations that followed, and a special revision detachment was employed for three seasons after Mathison had left, without even then establishing full confidence[5]. Similar failures in other districts led to the regular appointment of a civil Superintendent or Settlement Officer in charge of both survey and settlement operations.

It may here be noted that the settlements of the Orissa districts of Puri, Cuttack and Balasore, based on the surveys of 1837–42, were extended to a full sixty years, though originally intended for a thirty year period. The next survey and settlement of Midnapore took place after 1873[6].

[1] DLR. (117, 153, 166); 18-9: 21 & 27-9-42. [2] BTC. 12-3-42 (19). [3] BRC. 24-10-42 (13). [4] from Comnr. 22-11-42, BRC. 13-3-43 (73). [5] from DSG. 20-12-42 (48-51); ib. 17-5-43 (4); DDn. 562 (146). Rev Bd. to Rev Dept. 11-7-51. [6] *Imp Gaz.* xi (85-98); xx (46).

CHAPTER XII

REVENUE SURVEYS, LOWER BENGAL & ASSAM

Calcutta, 1841–3 — Sundarbans, 1830–41 — Chittagong, 1835–42 — Arakan, 1834–42 — Tippera, 1838–42 — Sylhet & Cāchār, 1836–43 — Lower Assam, 1830–42 — Upper Assam, 1838–43 — Methods of Survey — Outturns & Cost-rates.

CALCUTTA was a rich and growing city, and there were many difficulties in maintaining registers of landed property and its owners. In 1840 the Board of Revenue took legal advice before starting a survey of the suburban area

> called Dhee Punchawangong[1], rendered necessary by the difficulty which is experienced in identifying the numerous holdings, ... and by the supposed fraudulent alienations of land from the rent-roll [III, 136 ; IV, 177]. Such a survey could not be well instituted in Calcutta, in which, being under the jurisdiction of the Supreme Court, the laws of England would offer a bar to the prosecution of the survey of any lands...or tenements against the will of proprietors, who could have their remedy at law for trespass[2].

From 1841 Deputy Collector Michael Crow was employed

> in the survey and settlement of Punchanogram. ... Mr. Crow's attention has been devoted principally to field duties, and he has completed...the survey of two large subdivisions in the Soorah Division, comprising 94 holdings with an area of 335 beegas.
>
> The Deputy Collector's proceedings appear to be conducted with much judgement. ... In the neighbourhood of Chitpoor he experienced 'greater cordiality and readiness on the part of the landholders to afford the requisite information', and...'ground for two excellent roads has been allotted by certain zemindars, who have allowed a number of their trees to be cut down to open a free communication, ... and convicts are now constructing these roads'[3].

At the end of his first season Crow estimated that he would be able to survey and settle the revenue of about 8000 *bīghas* a year, more than 2,500 acres, at a cost of about Rs. 6,000. He hoped to complete the work in another four years, though he did not know exactly

> the entire extent of Punchannogrom. ... The villages...forming the boundaries...do not, in the absence of any map, ... enable me to discover the exact quantity of land included. ... I have, however, endeavoured, by marking out those boundaries in pencil on Captain Prinsep's lithographed map [III, 13], to ascertain...the general direction of the district boundaries[4].

Crow died in 1846 and the survey was completed by 1852 as part of the revenue survey of the 24-Parganas District. Probably about this period, a survey and map of the roads in Ballygunj was made by Alexander Daniell, whilst head-assistant in the Revenue Survey office[5] [268].

SUNDARBANS, 1830–41

A considerable length of the Sundarbans boundary had been surveyed before 1830 by Thomas Prinsep and Alexander Hodges [III, 141–4, 458–9][6]. Hodges was now working eastward through Bākarganj[7] under the general direction of the Commissioner, William Dampier, surveying and marking the limits of the reclaimed land. Government was anxious that the whole boundary eastward from the Hooghly River should be settled beyond challenge ;

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[1] Panchānnagrām — 55 villages, area 24 sq. m., tr. in 1757 from 24-Parganas Dist. as Govt. estate ; *Imp Gaz.*, XIX (378). [2] B to OD., Gen., 23–1–40 (131–3). [3] BRC. 23–5–42 (24). [4] from Crow 25–5–42, BRC. 1–7–42 (14). [5] *Ben Supply Regr.* 33 (S-57). [6] *Ben. Regr.* 98 (108, 115); lithd. maps by Hodges, 2-inch & 4-inch. [7] MBIO. 40 (5), ¼-inch skeleton map, 1836.

The Commissioner should himself go over the line, and determine on the spot it's accuracy or otherwise. If this had been done originally, the parties concerned and the public functionaries would have been spared much...vexation. ...

It is to be hoped, however, that the omission may now be supplied, and future litigation on this important point terminated. The Board are...to call on Mr. Dampier to proceed in person to that part of the boundary line which lies contiguous to Mr. I. O. Elias' estates, ... taking Captain Prinsep's survey maps, ... and employing the present surveyor, Lieutenant Hodges, accurately to lay down the true line wherever he may decide that Captain Prinsep's demarcation was erroneous, and carefully to supply all deficiences or ambiguities which he may detect[1].

In 1833 Government ordered that Hodges should take up the survey of "the islands and churs on the Meghna" as they "contain very considerable estates, then khas property of the State"[2]. Hodges started on Sandwīp, and at the end of his first season reported that he had

surveyed in the most minute manner about two-thirds...of the island. I propose proceeding forthwith to Calcutta to make an arrangement for an increase of establishment so as to commence operations in the field as soon as possible after the rainy season. ... My surveying establishment...is altogether insufficient...for carrying on a survey of this nature[3].

Government doubted the value of making a field-to-field survey of Sandwīp ;

It is in contemplation to increase the subordinate establishments of the scientific survey, and pursue the measurement under Lieutt. Hodges more in accordance with the system of the... Western Provinces [212-4]. ... It is indeed doubtful whether scientific survey of chur and alluviated lands, which must be constantly changing their exterior figure and area, is worth the expence. ... Where the work is...on a large scale, as in the estate of Sundeep, ... it should be brought to a conclusion as speedily as possible. ... The field measurements should be checked by the Surveyor, and the settlement should follow so immediately that a repetition by the Settling Officer...should seldom or never be necessary[4].

Hodges urged that the survey should be continued

for another season at least, to allow it a fair trial. ... My establishment was totally inadequate, ... having only one assistant, and even his services were withdrawn from me two months, being employed...on the talookdaree measurement, which was subsequently...abandoned. Having been upwards of a year attached to a revenue survey in the Upper Provinces [III, 157-8], I...can safely say that no information from that quarter would be applicable to my survey. The features of the land are quite different, and the...interior measurement in the island is doubly laborious[5].

The Board of Revenue agreed and pressed for an increase of establishment and completion of the Sandwīp survey ;

The local revenue officers...insisted upon having every field and every patch of land laid down in the map, which was found quite impracticable without an increase to the Surveyor's establishment. Moreover, the land is so much subdivided, and the holdings are so intermixed in Sundeep, as in Chittagong and the eastern districts generally, that the delineation of them... could not be accomplished except by...a larger scale of drawing than the usual...4 inches to a mile. ... The Board do not hesitate to repeat their former application for the appointment of a separate surveyor to the district of Chittagong[6].

After another field season on Sandwīp Hodges spent the rains of 1835 at Chittagong, and then took furlough ;

I made all the observations required for laying down...the station of Noacally, the islands of Hattia, Bamnee, and Sundeep, and the Chittagong coast to the eastward of Sundeep, from which the general map...has been constructed. ... What remains to be done is...a continuation of the measurement of mouzas, and the construction of plans...with table of areas, ... the above being added to my general map on the reduced scale[7]. ...

I propose my proceeding to the islands again in the middle of November, and placing the field operations on such a footing as will allow Mr. Parker [198] completing the survey...in the course of the ensuing season. This I shall be able to do by the 20th of December. ... Lieutt. Siddons should...receive charge previous to my departure, ... and...make...two or three of my native surveyors available for his survey at Chittagong.

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[1] BTC. 17-4-32 (7). [2] ib. 19-10-33 (29-30). [3] ib. 13-10-34 (25); from Hodges, 19-5-34. [4] from Rev. Bd to Comnr., 27-6-34 ; BTC. 13-10-34 (25). [5] from Hodges, 2-7-34. [6] from Rev. Bd. 26-6-34. [7] MRIO. Misc. 8-O-36 ; 12-O-39 ; plans of "Baumney & Noacolly", by Hodges ; copy by John Parker.

> Mr. Parker, who has been employed under me three seasons, is both clever and indefatigable as a surveyor. ... After concluding the survey he can return to Chittagong, and prepare the necessary plans, calculate areas, &c., and submit his work for Lieutt. Siddons' inspection[1].

The Commissioner in the Sundarbans maintained a surveyor permanently on his staff, and in 1839 Parker was directed "to define the boundaries of the Sundarbans waste according to Capt. Prinsep's map, and to lay down substantial and durable land-marks to prevent further encroachments". In 1841, Charles Mullins from the Chittagong survey was appointed Surveyor in the Sundarbans on a permanent salary of Rs. 200 a month and Rs. 100 for establishment, boat hire, instruments, and stationery, whilst in the field[2].

Early in 1835 a survey was carried out in the low swamp-land of the 24-Parganas and Jessore districts to the north of the Sundarbans forests, which is still, one hundred years later, largely under water during the rains. The Board of Revenue asked for a surveyor to accompany the Deputy Collector into the *mafasal*

> during the present cold season, in order that the external limits of the extensive and valuable tracts of swampy land...may be accurately defined and mapped. Several large tracts in the vicinity of Baraset, and...throughout the lower parts of zillahs Jessore and Nuddea, which might have been almost termed lakes at the period of the permanent settlement, and which consequently were not included in that arrangement, are gradually filling by deposits, and the annual growth and decay of vegetation. ...
>
> The contests of the land-holders, ... to obtain possession of the rich lands from which the waters recede season by season, are frequently attended with very serious breaches of the peace, and much vexatious civil ligitation. ...
>
> Bheel Bullee, ... 17 or 18 square miles, ... will yield to Government several thousand rupees per annum at present, and a much larger eventual revenue[3].

Morgan Blandford [III, 425 ; pl. 3] who had worked under Gerard many years before, and now had a business in Calcutta, was nominated for this survey on salary Rs. 300 a month, but died very shortly after[4].

CHITTAGONG, 1835–42

In 1829 the Board of Revenue asked for a new survey of cultivation and waste lands in Chittagong District, to ascertain the extent and boundaries

> of...lands which the zemindars...have surreptitiously annexed...or alienated since the year 1790, and since...the perpetual settlement [I : 140–1 ; II, 177–8]. The Commissioner strongly urges the expediency ...of...a survey of the entire district...under...professional European officers. ...
>
> He proposes that the survey shall commence with the Nizampoor pergunnah in the vicinity of Chittagong, which is the most valuable pergunnah in the district. ... The Commissioner suggests that the Deputy Collector shall accompany the surveying officer and investigate all claims to lands held exempt from assessment. ... The work of one season would enable the revenue officers to resume and bring under assessment lands, the revenue of which would more than suffice to cover the annual expense of the proposed survey [198][5].

It was some time before a competent surveyor could be found, though in 1833 Charles Guthrie [196] was employed for a few weeks "to survey and superintend the embankments of the Noabad and khas mehals". From October 1834 Henry Siddons was appointed Surveyor in Chittagong, to survey estates that had belonged to "the Ghosal family", of which the reversion to Government was under consideration[6]. He took full charge of the survey from Hodges at the end of 1835 [364].

Siddons was responsible only for professional control, working ahead of the detailed *khasrah* carried out by the revenue staff. After his first season he estimated that his survey would take four full seasons, and it was decided then to double his establishment and monthly expenditure[7].

By December 1837 work was progressing well ;

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[1] from Hodges, 29–9–35 ; BRC. 13–10–35 (8). [2] ib. 19–1–41. [3] from Rev. Bd 30–12–34 ; BRC. 13–1–35 (22). [4] ib. (23) ; 22–1–35 (26). [5] B Rev Bd. 7–7–29 (53–6). [6] BTC. 13–10–34 (26, 28). [7] BRC. 4–10–36 (35).

I have run many lines, fixed peaks, and observed latitudes, and have derived much information and assistance from Lieut. Col. Cheape's...rough protraction of his survey of Chittagong in 1815–16 [III, 137–8]. ... The only returns are the mouza maps, the thana maps, a statement of areas, ... and an abstract...classed "productive" and "unproductive". ... No landmarks whatever are preserved in the zillah. Oral tradition among the least intelligent... population I ever met with is the only record, except the chittas of former measurements in the Collector's office.

I have the powers of Deputy Collector, but have seldom used them.

His establishment now comprised—

Lieut. Siddons, ... @ Rs.	526 [346, 365].	1 apprentice	50 each.
2 senior sub-assistants	200 each.	6 native assistants	30 ,,
2 junior ,,	100 ,,		

The great source of delay here is in the intricacy of the village bounds. Since the first season I have been compelled, from the absence of previous arrangements by the revenue authorities, ... to instruct my subordinates to survey their portions of work en masse, ... the boundaries being settled by the Deputy Collectors. ...

The separation of the native from the professional survey is incompatible with cheapness or accuracy; I mean mathematical precision, and not the vagueness of approximation. I should myself have positively declined the task of superintending a native measurement in Bengal, ... but a man with his eyes open cannot help picking up experience, and if officers were attached as assistants before receiving charge of surveys, the want of it need no longer be an objection to the combination of the two systems.

Then, boundary surveys would be all that need be required from the professional assistants. Under scientific guidance good permanent Bengalee field nukshahs[1] might be prepared, showing every man's holding[2] [III, 148 ; IV, 200, 205–7, 229].

He thought it most extravagant to employ highly paid assistants on such petty detail as tanks, ditches, and roods of waste. ... Checked as the jureeb is by carefully selected officers with salaries of from 200 to 400 rupees, ... every useful purpose... would be met by the total areas only of villages being scientifically prepared.

The officer conducting the jureeb should furnish the surveyor at the conclusion of the measurement of each mouza with a detailed statement of his unassessable lands, the amount of which, deducted from the total area...should leave the assessable portion.

In any case where the native Deputy Collector was suspected of malpractices, the measurement of *one* village in detail would settle the point and *him*[3].

In December 1836 two of his parties were attacked by villagers ;

In the first-named village the chain was carried off and the party were allowed quietly to retreat to their camp. In A everything was carried off except the theodolite, which was rescued—broken—by the khalasis. ... The party was assaulted and the Assistant severely beaten with the iron-shod staff of his own flag. The loss of the fieldbooks...involved much loss of time and consequent expense. Nothing was ever recovered. ...

All the survey parties in Puttea were equally threatened, as well as the Deputy Collectors, three of whom were likewise driven from their work, and one severely beaten[4].

Weather was a constant obstacle to progress, and in May 1839 Siddons was compelled to stop the fieldwork...for the season. The heavy rain...since the 29th ultimo has now completely flooded the land, & my assistants report their wading above their knees. ... Boundaries cannot be accurately traced, while the definition of the scattered minute portions appertaining to some villages is impracticable.

Even in the office tent it is impossible to carry on work with regard to the preservation of the records, and to wait till the effect of this rain passes will only be to expose this establishment to another burst, which may now be expected[5].

A long expected consignment of drawing paper was ruined [209] ;

I attribute this entirely to the packing, which was executed by placing the paper in a long rectangular box made up of numerous pieces of old tin, most imperfectly and negligently soldered, instead of being sent in a tin cylinder with not more than 3 or 4 junctions [91][6].

Maiskhal Island, surveyed during 1838–39 was so densely wooded that it was only possible to survey the perimeter by sextant working from dinghies [III, 11, 147]. The original programme was completed in October 1839, and further work was then found till the rains of 1840 in *pargana* Amrābād [177], "at the head of the Bay of Bengal"—in Nizāmpur[1]—and in Teknaaf.

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[1] sketches or *shujrahs*. [2] to Bedford, 28–12–37 ; DLR. 36/42, (2). [3] ib. 36/50, 14–8–38. [4] ib. (7), 13–10–38. [5] ib. 36/42 (204), 11–5–39. [6] ib. (246), 17–8–39.

The long interval between the professional and *khasrah* surveys often led to disagreements, more especially in remote areas. Siddons accompanied the Commissioner to Teknaaf to investigate a particularly serious discrepancy found in the work of Owen and Guthrie of 1837–8. He records his

> entire approbation of Mr. Senr. Sub-Assistant Owen's work, which is extremely faithful and well executed. If I cannot bestow such unqualified praise on Mr. Junr. Sub-Assistant Guthrie's work, ... I can still assert that the survey is substantially correct, [and] that trifling omissions of detail observed by me can in no way effect the general result[2].

The Commissioner agreed that the professional survey appeared above reproach, but ordered a resurvey which Boileau carried out later, from which it appeared that "the principal difference was caused by a new line of boundary between the two villages, ... and a considerable reduction in the cultivation" that had taken place since the first survey. Owen, the original surveyor, explained that

> upwards of 3 years have elapsed since my survey, ... a period in which...the features of a country undergo considerable changes. ... I was distinctly informed that my survey...should embrace only the cultivated tracts, and that the wild and hilly portion of it should be entirely omitted. On reaching my destination...in a very remote corner in the Chittagong District, my disappointment was excessive owing to the reluctance of the Mugs to...render any assistance in the way of defining the various details of the land. ...
>
> I was therefore compelled to prosecute the desired survey on the meagre information furnished by those whom the mere desire of gratifying curiosity drew around me, and...without any public documents to guide or check my proceedings. ... Deceived by the dense jungle, ... my plan is a faithful portrait of the country as I saw it[3].

Discrepancy found along the junction with the Tippera survey to the north, was found to be due to an incorrect value for magnetic variation used by that survey [203]. On his own side, reports Siddons,

> the Chittagong meridian was deduced from a series of Sun's azimuths and amplitudes...in 1837. The survey was first carried on by various parties each working on the magnetic meridian of their respective theodolites. When the operations became so far advanced as to render combination necessary, the inconvenience of this was discovered, and the magnetic meridians were all referred to the true one[4] [203].

He knew that the survey was not of a high professional standard, and had been

> begun under the disadvantage of not knowing how far it was intended to be carried, Government considering it merely an *experiment*. This difficulty was added to in the first season by the Deputy Collector...selecting scattered spots...for the commencement. ... In consequence the mapping has been more of a patchwork than I could wish. ... As operations became more certain, ... and as the survey emerged from the jungle tracts, the requisite steps were taken for ensuring its accuracy as a whole.
>
> The map is first divided into *villages* ; the market places and salt golahs...are marked. ... The moonsiff's *chucklahs* are the next division, ... but the boundaries being not known even to the Judicial authorities, little more than the names can be given, and the locale of the kutcherree. ... From every public office here there will...be a requisition for this map, and I...recommend copies being made now of the central and southern parts, and after this season of the northern, as this is the only document preserving the results of the survey as a whole.
>
> The field books, prior to the Deputy Surveyor General taking charge for the season 1837–38, have been kept in all manner of ways, some in ink, some in pencil, and are in an unintelligible delapidated state, whilst the first rough protractions have all been altered and exposed till they are little better than rags. Lieut. Siddons is well aware how wrong all this is, but can justify himself firstly by the urgency with which his operations were pushed forward in the 2nd and 3rd seasons of the survey ; 2ndly by the fact that at that time there were few trained assistants in Bengal, and such as were procurable were suffered to pursue their own systems, as preferable to incurring any delay[5].

At the end of the rains of 1840 Siddons handed over to his senior assistant, Edward Boileau, who brought work to a close by 1843. He reports in April 1841 ;

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[1] *Imp Lib. M & P.* (123), 1837–40 ; 2 inches to a mile. [2] DLR. 36/43 (3), 16–1–40. [3] from Owen, 23–4–41 ; DLR. 37/51. [4] DLR. 36/43 (65), 30–10–40. [5] ib. (67), Oct. 1840 ; cf. *PR.* (35) ; DDn. 542 (166), Waugh, 20–10–50.

> I have...my immediate duties as a surveyor to attend to, but am obliged to devote 3 or 4 hours during the day to purtal calculations. I also devote one hour before breakfast and another hour at night, so as to bring my test to a speedy close. ...
>
> On account of my unremitting attention to my double duties whilst at Teknaaf, I nearly lost my eyesight, and was compelled on account of an affection of the eyes, brought on by protracting...by candle light, to leave off work of every kind for one week.
>
> To make up for that delay, I would proceed to my field duties before the sun rose, and would close my field book at sunset, reaching my tent near the only tank of good water...late at night. I had neither horse nor bearers to carry me to the spot from which I was to commence my day's work. ... I seldom retired to rest before 12 at night, and, when extra attention was required for the monthly papers, the morning has dawned on me. Mr. Commissioner Harvey can inform you what my appearance was on my return from Teknaaf[1].

During season 1842–3 Boileau and his two assistants were engaged on an experimental cadastral survey in *thāna* Puttea on scale 16 inches to a mile [180–1].

ARAKAN, 1834–42

In 1834 a detachment from Sahāranpur under Patrick Chill[2] was deputed to Akyab to test the work of local land-measurers by surveying

> the cultivation of two or more circles in each district, with a view to prove the general accuracy or otherwise of the...soogrees, and the advantage, or otherwise, of continuing the same, or some modified, system of land survey. ... It should be made known...that this scientific survey would commence next year, leaving the selection of the particular Circle till the moment when the survey is to commence, that the soogrees may have time to consider the advantage to themselves of establishing a character for honesty and accuracy by making true returns[3].

Work was started in Akyab District, but within a month the whole party was back "under medical care of the Surgeon", and lost no time in returning to Calcutta. The Commissioner was deeply disappointed

> at this unfortunate commencement of the first attempt to effect a survey of this province, but I trust the present failure will be no barrier to a renewed attempt under more favorable circumstances. ... The party did not reach Akyab until the latter end of March 1835, which place they left for Lapraimobra, the scene of their operations on the 30th of that month. They were engaged in the interior from the 1st to the 18th of April, but actually employed on the survey only five days of that period, during which most of the party were taken ill with fever. ... Four villages were surveyed, the total area of which was 2894½ acres. ...
>
> The difference between the results of Mr. Chill's measurement and the returns furnished by the village officers was in each case inconsiderable. There was in one instance a difference of seventeen beegas, and in the other of seventy. ... The accuracy of the native returns was shewn to be far greater than could have been expected[4].

The survey was not resumed as the small amount of revenue in prospect was not considered to justify the expence[5].

In 1840 the Commissioner asked for a survey of Cheduba Island,

> having received applications from European gentlemen of large capital for two grants of waste land, to the extent of 10,000 acres each, on the island of Cheduba. ... It is exceedingly desirable to have a regular survey of that island immediately, not only that the grants now applied for may be...accurately defined, but...that it may be seen what further grants may be given... without prejudice to...the present cultivators.
>
> The island comprises about 100,000 acres, of which not more than 5 or 6,000 are cultivated. A great deal of the waste area is composed of hills and is unfit for anything, but it would not take much time to survey the whole. ...
>
> There are about 10,000 inhabitants on the island. If the grantees who now wish to locate there succeed, they will doubtless import several thousands of ryots from Bengal, and the extensive growth of sugarcane, hemp, cotton, tobacco, black pepper, and various other valuable products will be the result. ... Without a survey of it we are all in the dark, and hardly know what tracts can conveniently be assigned away, and what not. Neither can grantees readily select those lands which are best suited to their purpose[6].

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[1] DLR. 36/43 (132), 21-1-41. [2] A. Saviell [398], 10 Indian measurers and several *khalāsis*. [3] **Calcutta, 29–3–34,** BTC. 29–9–34 (6). [4] B to CD. 3–3–36 (2–5). [5] BRC. 24–9–38 (22). [6] from Comnr. **Akyab, 10–10–40 ;** BRC. 29–12–40 (21).

Mr. N. J. Hudson[1] was appointed "Surveyor under the Commissioner of Arracan" by order of 24th November, and after completing Cheduba his party was kept on another season to survey the island of Akyab. During the rains he was released, and the survey carried on by his assistant Mr. A. Hudson, who resigned in December 1842, the Commissioner reporting that

> as Mr. Hudson has given little proof of zeal in the service...I have allowed him to quit Arracan, and I do not think his departure will be any loss, neither can I recommend his being employed again. I propose to carry on such surveys...with the native establishment...and a native draughtsman whom I have engaged at 40 rupees a month[2].

TIPPERA, 1838–42

The survey of Tippera District, which lies on the left bank of the Surma River to the north of Bhulua, or Noākhāli, was started by Joseph Phillips, of the Artillery, towards the end of 1836, with two assistants. He had a number of *amīns* under his charge for "native measurement". His outturn during season 1838–9 was only 56¼ square miles. During 1839 his senior assistant, Brown, was ordered to Cuttack, and he was given younger men from Monghyr and Chittagong. Bedford attributed his small output to

> 1st. Total want of native surveyors, whom...Lieutt. Phillips had neglected to instruct.
>
> 2nd. Want of...properly settled boundaries, by which much valuable time was lost.
>
> 3rd. The dispersed nature of the lands under survey. ...
>
> 4th. Sufficient work does not appear to have been...provided, ... for...latterly one of his four assistants had nothing to survey [179, 184]. ...
>
> 5th. The purgannah of Doorbye was not ordered for survey untill just prior to the premature close of the season by an unusually early rains. This prevented Lieutt. Phillips from completing an extensive main circuit. ...
>
> 6th. Lieutt. Phillips' time and attention seem to have been too much taken up with boundary settlements, instead of being confined...to mere survey duties[3].

The Board of Revenue did not agree that the survey had been "*a clear failure*", and pointed out that Phillips had been employed on survey of

> the Government share of pergunnah Buldakhal and...of some detached churs. The lands of Buldakhal lie very much scattered. ... Great as has been the necessary expence, ... the value of the property (which yields a net profit over...the permanent settlement of more than a lac of rupees), and the necessity of having it accurately defined, fully justify the outlay[4] [178].

For season 1839–40 Bedford hoped "for better success. ... An efficient establishment of native surveyors has been provided. The boundaries are reported to be better prepared ahead, ... and sufficient work...provided to give uninterrupted employment". His expectations were justified; and the party surveyed

> a variety of khass land in 13 pergunnahs or mehals, ... with 59 churs of the Megna, Dalasurree, and Dukairea rivers. A number of connecting surveys (rendered necessary by the detached nature of the operations) were also made, and but for the failure of the assistant, Mr. J. Parker, one of these would have been of great value in a geographical point of view by combining the Tippera, Bullooah, and Chittagong surveys with the accurate triangulation of the Megna River by Major Wilcox [265–6].
>
> The operations of the new season are under...Mr. W. A. Wilson, a steady uncovenanted assistant...who was appointed to the charge...in October last. ... Season 1840–41 will embrace ...khas lands in nine purgannah tuppahs, ... while parties will...be detached...to bring up the .. arrears of last season left undone in consequence of their not being pointed out[5].

Phillips took furlough at the end of the rains of 1840, and handed over to Wilson on 29th October, who reported for season 1840–1 that

> Mr. A. Smith and party were on detached duty on the churs of the river Megna during the best part of the season. Mr. late assistant Parker's station marks having been effaced from the ground precluded...any revision...of his errors. The work was rejected and re-surveyed. ...
>
> The opposition of the jageerdars was felt in every direction; so much so, it became a matter of the greatest difficulty to get a single ryot to attend the measurement. Even the Government

---

[1] d. Calcutta, 30–9–42, aged 24 y. 11 mo.; possibly related to Nathaniel Hudson, from 1817 Attorney, Calcutta. [2] BRC. 21–2–43 [140]. [3] from Bedford, 13–1–40; Rev Bd. 11–3–40 (77). [4] BRC. 13–3–40 (12). [5] ib. 16–2–41.

> ryots were now afraid to point out the land-marks. Talookdar Sumboobooan, having collected about 200 men armed with clubs, suddenly attacked my assistant Mr. Hayward and his party ...in pergunnah Hamnabad on the morning of 13th April 1841 ; [several] were severely beaten, and Mr. Hayward obliged to repair hastily to a neighbouring village[1].

At the close of season 1841–2 Wilson took the party down to Calcutta where he finished off his reports and maps[2], and the party was broken up on 15th October 1842.

SYLHET & CĀCHĀR, 1836–43

Thomas Fisher had long been associated with Sylhet and Cāchār, as surveyor, as an assistant on the Quartermaster General's staff, and as Political Officer [III, 144–5, 447–8]. In 1830 he was in political charge of Cāchār, keeping an eye on the *amīns* employed on "the measurement and mapping of distant spots of unappropriated jungle land" in Sylhet. In December 1834 he undertook to supervise a survey of Cāchār by *amīns* at an annual cost of Rs. 700, that he estimated would yield an increase of revenue of Rs. 3,000 a year.

At the end of 1836 sanction was given to the professional survey "of the champaign country of Jynteea attached to Cachar...upon a plan somewhat similar to that followed in Chittagong", and on 3rd January 1837 Henry Thuillier was appointed to charge of this survey[3].

These six *parganas* lying in the plains north of the river Surma had been annexed by the British from the Rāja of Jaintia in 1835, and absorbed into Sylhet District[4]. The Superintendent of Cāchār was directed to be present

> whilst the survey is going on. ... The sooner...a settlement is concluded...the better.
>
> The work of the scientific surveyor by no means includes the exact measurement of each portion of land held by the cultivator. The general area...is ascertained by the surveyor, but the contents, and how these are occupied, are filled up by the subordinate ameens. ... The presence of the Superintendent to direct and check the operations of the ameens, ... and to conclude a settlement close upon the heels of the measurement, is...quite indispensable. ... Your undivided attention and time may be given to the Settlement of Jynteah[5].

In July 1837 Thuillier reported that

> the total quantity accomplished this season, i.e., since the first of March, amounts to 7,766 koolbahs[6], ... and even this has only been done by working the whole day in the field, having had many difficulties—...not only the lateness of the season and wet state of the country—but my assistants were totally inexperienced and unable to act by themselves, and the tuition so absolutely necessary was not likely to accelerate my progress. ...
>
> The scientific survey will proceed next season more rapidly, but the native measurement... is very tedious...owing to the very minute divisions of property and continued disputes of the land holders, enabling the ameen to measure not more than three or four koolbahs daily. ... I employ nine of these men.
>
> The khasreh work is...on contract at the rate of 100 koolbahs of cultivation for 15 rupees, and the same quantity of jungle for 4 rupees, the aumeens finding their own establishments of mohurrirs. ... I had much difficulty in obtaining aumeens at this rate, and was only enabled to do so by...a higher payment, vizt. 5 rupees each per mensem. ... The waste lands are not measured by the aumeens, but the cultivated and fallow land only[7] [189].

He asked for the loan of two elephants ;

> The country...is so thickly covered with jungle...that we found it impossible to penetrate...without the aid of elephants, and...the interior...is far worse. Two of my assistants who have traversed nearly the whole area in boats as far as the hills...say that about Jynteepore the people will not enter the jungle by any persuasion owing to the...tigers and other wild beasts[8].

Amongst other duties it fell to Thuillier to demarcate the boundary between the Khāsi and Jaintia Hills ; "in Jynteeah, hitherto, no known boundaries have ever existed, and it has been the main object of my operations to define them"[1]. By the end of 1839 he had completed the six *parganas*[2] ;

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[1] DLR. 36/38 (7–10), 19–1–42. [2] *Imp Lib M & P.* 108, 313, 446, 454, 513, 933 ; *pargana* maps 1830–40. [3] BRC. 3–5–36 (26) ; 28–1–37 (28) ; 21–3–37 (37). [4] following outrage on Sylhet persons, *Imp Gaz.* XIII ; XXIII (191) ; Allen (27–32) ; *parganas Khurred, Chootool, Chowra, Churcutta, Faljoon, Bajac Raj* ; DLR. 36/6 (15), 14–6–39. [5] from Comnr. of Rev. 7–1–37 ; BRC. 21–3–37. [6] 1 *koolbah* = about 54¾ *bighas*, or 18 acres [III, 148]. [7] from Thuillier, 22/30–7–37 ; BRC. 19–9–37 (41). [8] DLR. 37/61 (20), 1–2–38.

> Every mouza has been distinctly separated, and the boundaries marked, ... and the larger division or porgunnahs likewise definitely arranged with fine natural boundaries. Previous to the survey the whole district was...subdivided without...uniformity or compactness. Every village contained lands of five or six outer villages intermixed with its own.
>
> The Bengalli measurement has been carried on with the compass, and the strictest purtall exercised over the aumeens, the difference between the areas of the two surveys not exceeding 1 per cent. The best proof of the correctness of the aumeens' work is the readiness with which the ryuts enter into their engagement. Not a complaint has been made against any of the survey records, and the Bengalli colored maps will continue to form a valuable reference, both in the Magistrate's and Collector's offices, after the settlement is finished.
>
> Of the English survey, separate colored maps of every village, bound up in convenient volumes—a large plan of each pergunnah, as well as three general plans of the whole district for more ready...reference—have been lodged in your office, and a geographical map on reduced scale is in the course of preparation[3].

From 1840 to 1841 Thuillier was absent in charge of the Puri survey [186], and on his return in October 1841 he took up the survey of Cāchār, which was completed by April 1842[4] [pl. 9]. He then took up an experimental survey in Sylhet, where he laid out *pargana* boundaries "recording all within the same boundary by one name. ... No detailed survey of the whole district ever having been made before, the demarcation parties have had to *make* boundaries"[5].

He was again called away for temporary charge at Patna [185], leaving his senior assistant John Kelso working on the records and maps, on which

> details...were extremely heavy, ... the demarcation, ... khasrah measurements, and settlement ...records, all under my sole superintendence. ... The...khasrah maps, constructed by scale and compass, ... are such as are not prepared in other districts, and their value in the local offices have been often acknowledged [207, 220–30]. ... These maps will take some months to complete and, the Cachar district being under settlement, their correctness and speedy transfer to the local authority is a matter of the utmost importance[6].

Thuillier returned to Sylhet before the rains of 1843 ; and later in the year reported that a quantity of his records had been destroyed by a fire in the Deputy Collector's *kachāri*, but that "by great exertions I was enabled to replace the whole of the chittas before quitting Sylhet"[7].

He finally closed down work in November 1843 and started for furlough, handing in his maps and reports at Calcutta during February 1844[8].

LOWER ASSAM, 1830–42

Revenue surveys had been started in the Assam valley in 1827 by David Scott, Agent to the Governor General [III, 146, 501]. They were carried out by local measurers under European surveyors, of whom Paulet Mathew died in 1832 [III, 484]. Scott had died at Cherrapunji in 1831, and on Mathew's death the new Agent, Francis Jenkins, writes ;

> Altho' it may ere long be expedient to abolish the office of the Revenue Surveyor in Assam, yet, if this were to be done immediately, much valuable information which...the native assistants are quite incapable of digesting or protracting on paper would be irretrievably lost. ...
>
> An assistant surveyor...may...be deputed...to arrange all the materials left by Mr. Mathews, reserving...his permanent employment for after consideration. ... The average annual expense of...the survey establishment, ... rupees 11,000, is considerable when compared with the revenue actually received, but not at all so with reference to that which...may be brought to yield[9].

One of the Surveyor General's office draughtsmen, Christopher Hudson, was deputed to Assam to arrange and protract the unfinished revenue surveys ;

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[1] DLR. 36/6 (41–2), 27–7–39. [2] MRIO. 34 (14) ; scale 1 inch to m. ; ¼-inch map, 61 copies by litho. 20–12–42 ; cf. MRIO. 36 (38). [3] DLR. 36/6 (69–82), Feb. 1840 ; (83), 24–9–40. [4] DLR. 37/60 (72), 1–4–42 ; (92), 1–5–42 ; ¼-inch maps, Cāchār, MRIO. 34 (4, 23). [5] DLR. 37/60 (42), 31–12–41 ; (105), 18–6–42 ; ¼-inch map, Sylhet, 1841–2, *Imp Lib M & P.* (164). [6] from Thuillier, Patna 6–2–43 ; BRC. 27–2–43 (40). [7] DLR. 37/60 (225), 14–12–43. [8] ib. (236), 3–2–44. [9] to Ch. Sec., Pol., 12–9–32 ; DDn. 281 (39–42).

Mr. Hudson's salary...has been fixed at sonat rupees 150, with an allowance of rupees 100 for travelling. ... To enable him to join...at Gowahuttee he will...draw two month's allowances at the general treasury, reckoning from the 1st November as the date of his appointment[1].

Hudson took charge of the survey as well as of the mapping, and the A.G.G. asked leave to keep him for another year;

From the fluctuating nature of the cultivation in Assam, and the migratory habits of the people, the surface of the surveyed country has in many instances been entirely changed...and ...the objects for which the survey was originally instituted have not yet been obtained[2].

In January 1834 the Collector submitted the map of Northern Kamrup as it now is, ... compiled entirely from the fieldwork of native ameens. ... As these were employed in various quarters at the same time, their labour comprising not less than 150 separate and distinct surveys, it must be clear that had they not been singularly accurate their work never could have been put together. The extreme diligence of Mr. Hudson in compiling the whole from about two hundred separate drawings entitles him to the highest credit. ... I have ever found him most zealous...in the superintendence[3].

Hudson himself reported that during season 1833–4 he had entirely brought up and protracted the arrears of field work of the years 1830 31 and 32, and a part of 1833–34. ... I have...supplied the Collector...with a map of Desh Darrang, and... I am now making a map of Southern Camroop from the field work of 1833 and 34, which...will require nearly another year to complete.

The six native surveyors...have...been employed in filling up the unsurveyed portions on the compilation of the map. ... There are four other native surveyors...who have been employed this season...in surveying the country round about Nowgong. ...

In addition to the protracting and compiling...I have...supplied you with calculations of the area of the greater part of your northern district, ... the substance of the survey, without a record of which the whole work would have been perfectly useless. ...

I would strongly recommend that the combined strength of the...surveyors be brought to bear on one district at a time, ... as, from the men being in two districts lying far apart, I cannot control them so efficiently as if they were working near me[4].

The Collector agreed that the area statements were the essence of the thing. ... I have been enabled to make settlements which are in every instance most satisfactory, not only from the increase of revenue they yield, but from the circumstance that the data is so good, and the survey so exceedingly minute and accurate. It... precludes all dispute, and the money is realized. Mr. Hudson has also compiled some highly valuable maps, which have been of the greatest use...in apportioning the country into chowdreeships, and are of daily utility in every department, police, judicial, and revenue. ...

Had settlements been made when the country was surveyed, instead of on the...information furnished by the Assamese ameens, who cost much money, and only gave the area as they best could, without making any survey by angles which could have been protracted, all the confusion...might have been avoided, and...the revenue would ere this have greatly increased. ... It is only now that the survey is coming into regular play.

A revenue survey is...of service...to an unusual extent in Assam, whether we take into consideration the enormous quantity of land...claimed as lakheraj [185, 213], and the great importance in a police point of view of accurate geographical information.

Adverting to the very small expense of the survey establishment, the talent and industry displayed by Mr. Hudson, and the great assistance it is in his power to give me, ... I...recommend most earnestly that it be continued for some time longer. ... To abolish it within this year, when so much of the work is on the very eve of being completed and proving profitable, would be to sacrifice much of the past labour and expense. ...

Throughout the present rains he has been enabled to keep the native surveyors in the field. Their industry is as creditable as their pay is small[5].

The Commissioner, Francis Jenkins [III, 454 n.5], agreed that the survey was in the highest state of efficiency, ... but the maps...are still imperfectly filled up and disconnected. ... I promise to follow up the suggestions of Mr. Hudson...to call in the detached surveyors to fill up and connect the surveys already executed. ... There would still remain...our boundary on the Garrow and Cosseah frontier unsurveyed, and...this should be defined. ... Only within the last month disputes of a very dangerous nature have arisen with...both the Kyrim and Jynteah Rajahs[6]...from a misunderstanding respecting our rightful boundary.

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[1] B Pol C. 29–10–32; DDn. 281 (39–42). [2] from AGG. 11–9–33; BTC. 24–9–33 (15). [3] from Collr. 27–1–34; BTC. 12–6–34 (15). [4] Hudson, to Collr. Kamrup, 27–8–34; BTC. 29–9–34 (45); maps of Kamrup and Darrang, MRIO. 34 (15) and DLR. 37/75 (143). [5] BTC. 29–9–34 (45). [6] in the Khāsi & Jaintia Hills.

> The ryots...quietly yield to the...regular survey, whereas all previous surveys by ameens, incapable of producing measurements that could be mapped, only lead to...uncertainty, and further often-repeated surveys of the same kind. ...
>
> About half a lac of rupees at least must have been expended on a survey, if not totally useless, ... that might have been deferred. I refer to the trigonometrical survey of the islands and shifting banks of the Burhampootra...which serve only the purposes of science [265–6][1].

Hudson's surveys, writes Jenkins, would

> form complete maps of the province suitable to every purpose, military or geographical, being founded on the survey of the Burrampootur by Messrs. Wilcox and Bedford and others, which was conducted by triangulation and accurate observations [III, 53–5][2].

In his report for season 1835–6 Hudson reported from Nowgong that

> 12 native surveyors were employed in the field, 5 of them...to measure the unsurveyed portions of Kamroop...and with the other seven I came up here early in November...to complete the survey of this division. ... The greatest part...has been a jungly country infested by wild animals, and breaking through it on foot has proved no small obstacle. ... Yet...the... land surveyed is almost double what was last season, thus making a still further reduction in the expense, viz., from 20 to about 13 rupees per square mile[3].

To form a new party for upper Assam [203], Hudson offered to surrender his own men who had practically completed the survey in Darrang. He would keep a few men to resurvey part of Kamroop where "the old survey...made about 8 or 9 years ago has now become almost obsolete from the great increase of cultivation", and might be able to "find 3 or 4 other qualified persons among the oomedwars"[4]. In 1838 he was posted to the provincial civil service, and the following year relieved altogether from survey duty[5].

Hudson was succeeded as Surveyor in lower Assam by a young assistant surveyor, James Bedford[6], who commenced a survey for the break up of the large estate of Karibari[7] in Goālpāra. The monthly cost, Rs. 352, was to be charged to the proprietors, one of whom petitioned that survey by an *amīn* would be just as satisfactory, and far less costly; "the measurement by compass is not understood by the shareholders, as well as by the inhabitants, it not being here the regular mode of measuring lands[8]". For good reasons the "European survey" was carried through.

In May 1841 the Collector pointed out the undefined state of the boundary

> which...separates us from Botan. Part of this boundary was surveyed by Lieutt. Brodie and Captn. Rutherford [III, 64], but I...suggest...surveying the whole line and erecting solid pillars of masonry. ... This is the first work...for Mr. Bedford after the Carribari Estate is finished.
>
> I further...represent the...numerous law suits...occasioned by the impossibility of the boundaries of the various zemindars' estates being settled without regular surveys. ... In... the zemindaries of the Rajah Bijnee, where land has been given...for services, those who originally got possession...of one or two ploughs of land, now are in possession of 20 or 30 or upwards, for all of which...they refuse to pay land rent. ... All this could be avoided by a regular measurement which would define the rights of individuals as well as the Rajah[9].

The Commissioner endorsed the need for such survey, and added that

> north-east Rungpore has never been surveyed, and...the surveyed parts...of Bengal on the west, and Assam on the east, ... continue disconnected until a regular survey has been completed. ... The...boundary of the Goalparah Division...with the Bootan Dooars remains to be finished...from the want of officers. ... The...boundary with the independent Garrows has never been surveyed, nor the boundaries of the Garrow khass mehals [205]. ... A partial and hasty survey of the Garrow frontier was undertaken many years ago by the late Major Schalch; he left, however, from sickness, and what he did perform is now of little or no use, from...his not having determined any boundaries of estates or mehals [III, 49][10].
>
> If the zemindars wish for a detailed revenue survey of their estates, or of their boundaries... the expence...should be defrayed by them. ... I fear, however, from the poverty of all the zemindars...that there will be much difficulty in obtaining their concurrence[11].

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[1] from Comnr. 13–9–34; BTC. 29–9–34 (44). [2] from Comnr. 25–6–36; BRC. 2–8–36 (39). [3] from Hudson, 15–9–36. [4] "hopeful candidates": from Hudson, 18–9–38; ib. 30–10–38 (39). [5] from Comnr. 8–3–42; ib. 5–9–42 (65). [6] nat. son of the DSG [394]. [7] 1,000 sq. miles area, about quarter of Goālpāra Dist. [8] petition of 30–8–39; ib. 19–12–39 (40). [9] from Collr. Goālpara, 10–5–41; ib. 26–10–41 (65). [10] MRIO. 34 (12); Goālpāra, from surveys by Wilcox, 1830–1; Schalch, 1816–7; Scott, 1822; Bedford, 1839–42; drawn, C. Joseph, 1845. [11] BRC. 8–6–41 (50).

> I would...employ Mr. Bedford in the examination of the coalbeds which he lately discovered in the Garrow khass mehals of the Carribarri Estate[1]. These beds are situated in a locality so very favourable for the supply of coal to the eastern parts of Bengal, that it seems very desirable that their extent and value should be as correctly ascertained as possible. The survey should be made...at the expense of Government.
>
> Mr. Bedford has...executed his survey in a very satisfactory manner, in spite of the constant illness and death of his assistants, and his services are the more valuable as he appears not to be affected by the climate of the low Garrow Hills, which few gentlemen indeed would have been able to encounter with an impunity[2].

The full survey of Goālpāra was approved, but not seriously taken up till 1848, for Bedford's party was broken up at the end of 1842[3] [181]. The Deputy Surveyor General gives the following account of its work ;

> The Goalpara survey commenced early in 1840 under...the local authorities, and during the seasons 1839–40 and 1840–41 the butwarrah survey [187 n.5] of the Kareebaree estate... was completed by Mr. J. Bedford. ... At the end of 1841 a mehal survey of the entire zillah of Goalparah was deemed desirable, and the general superintendence...transferred to this office.
>
> The mehal boundaries not being ready...at the commencement of 1842, Mr. Bedford was in the first instance employed in surveying a disputed...boundary along the Bootan frontier, and afterwards...several valuable coal mines which he had discovered. ...
>
> The regular survey operations were thus delayed until March last, and...impeded...by opposition from the neighbouring landholders, so that by the end of the field season not more 188¼ square miles were surveyed. ... Mr. Bedford has recently been employed in making a few local surveys at the request of the Collector, and mapping the same, but on or before the 31st instt. the Goalpara survey party will be broken up[4] [181].

On taking over professional control of the Assam surveys in January 1841, the Deputy Surveyor General found much to criticise. From the lack of scientific control the maps had little geographical value, and, writes Kelso,

> survey...was by the prismatic compass. Every ameen was allowed one which had its own magnetic bearing. As different instruments have been used in one pergunnah, there can be no accuracy [196]. At points where maps should meet there are discrepancies of 30 and 40 chains. ... The maps may suffice to give the civil authorities an idea of the localities for revenue purposes, but as data on which to compile district or any geographical maps, I conceive them to be quite useless[5].

UPPER ASSAM, 1838–43

In November 1838, John Thornton, from the Chittagong survey, was posted to charge of the revenue survey of Sibpur and Lakhimpur districts of upper Assam, working under the Revenue Commissioner, Francis Jenkins. From Thornton's standing and ability, writes Bedford two years later, he would probably

> have been appointed to the charge of one of the regular surveys had he not been transferred to Assam. At present [he]...is entirely without aid in the general map work, and obliged himself to construct and copy them for the local officers. From a similar want of draftsmen the records of many years' survey in Lower Assam...are in danger of being lost for ever, as no returns have been made, either to the General or Revenue Survey Department[6].

Thornton's establishment was then increased from Rs. 600 to 918 a month, but though both the Collector and Commissioner expressed complete satisfaction with his work in support of the district settlements, Bedford had by January 1842 received no "maps, professional calculations, or statements of the work performed" though Thornton appeared

> to have been doing his best to bring up existing arrears. ... In the midst of this important work he was suddenly directed by Lieutt. Brodie (in his capacity of principal assistant to the Governor General's Agent) to accompany him on some journey into the district. ... If Officers in charge of surveys be subject to...peremptory orders of this nature, ... it is quite impossible for me to exercise any efficient control, or for them to be responsible either for timely departmental returns or for the accuracy of their general work[7].

---

[1] *JASB.* VIII (948–63) ; *Coal Beds of Assam*, Hamilton Vetch, 1837 [205 n.3]. [2] from Comnr. 21–9–41 ; BRC. 26–10–41. [3] BRC. 7–12–41 (79) ; 15–1–44 (10). [4] from DSG. 20–12–42 ; BRC. 17–5–43 (4). [5] DLR. 37/75 (46), to DSG. 3–1–49. [6] from DSG. 30–11–40 ; BRC. 19–1–41 (49). [7] from DSG. 17–1–42 ; BRC. 13–6–42 (6).

By the end of the year, however, Bedford received the statements

> for 1841–42...with the maps and traverses of eight tangoonees, surveyed and proved for 1940–41. ... The area returned for 1840–41 is 248½ square miles, and for the last season 1264½ —The work of 1841–42 extends over six tangoonees between the Burhampootur River and Naga Hills, and eight khunds of a large island—... The terms tangoonee and khund appear to be locally applied to the minor division elsewhere called purgunnah[1].
>
> The Seebpore Division, including the island above-named, is now completed, besides some of the interior work in Lukhimpore, on the main circuits of which Mr. Thornton is now about to commence. ... He will have full employment in the field and office for two seasons[2].

Survey was not without adventure, and one of Thornton's men sent to survey

> a mouza boundary took with him a number of coolies into the jungles of Lakhimpur. When near the hills, the hill tribe called Duphlas came down in a large body on the night of the 20th May, and beat and plundered the whole party, and with other things took compass and chain[3].

The tea plant was first reported from Assam in 1823 by Robert Bruce[4], whilst imprisoned by the Burmese at Rangpur [III, 52]. It was noticed by Wilcox on his journey from Sadiya to the upper Irrawaddy in 1827 [III, 61], the very year in which Dr. Royle had first suggested its cultivation in the Dūn [168]. By 1834 a Tea Committee had been formed in Calcutta, and Jenkins and his colleagues in upper Assam were searching enthusiastically for "the genuine tea-plant". Its discovery "in the vicinity of Beesa" was first reported on 17th May 1834 by Andrew Charlton[5], and confirmed by Dr. Wallich of the Sibpur Botanical Gardens. In 1835 Doctors Wallich, McClelland, and Griffith, were sent on a special mission to Assam to make further investigations [264].

In the *Journal of the Asiatic Society of Bengal*[6] appeared a *Report on the manufacture of Tea, and on the extent and produce of the Tea Plantations in Assam*, and also a *Map of Muttuck, Singpho, and the Country West of the Booree Dihing River*, "shewing all the Tea Tracts that have hitherto been discovered by Mr. C. A. Bruce[7], Superintendent of Tea Culture to the Hon'ble East India Company, 1st June 1839". A larger map, in 5 sheets, ¼-inch scale, was published by Tassin [312].

The Matak country[8], home of the Morans or Mohamarias [I : 81, 399] lies between the Brahmaputra on the west and north, and the Buri-Dihing on the south. Bruce's map shows closest cultivation of tea on the Tingri River near Tinsukia.

In November 1839 the Commissioner in Assam was directed to draw up rules for "the granting and measuring of the Tea Tracts, as...applied for by Companies or by individuals". Maps were to be sent from the Surveyor General's office, on which his assistants were "each to fill up...such topographical detail as they might be able to furnish"[9]. Finding little help from maps in his office, Bedford agreed with the Commissioner that "a professional officer" should be appointed

> to prepare a map, and collect all possible information, geographical and statistical, connected with a portion of the British Dominions now daily rising in importance. ... Little as we know of the correct positions of places in Assam, the results of a survey conducted by an able officer would...be highly valuable. ... The most recent information (including the Tea Plantations) will be found in a map now...being lithographed by Mr. Tassin, and it might probably better answer the object of Government to supply Captain Jenkins from that source[10].

He suggested that Robert Ellis, now available from Monghyr [184], might be placed "exclusively under the orders of the Commissioner like other Assam surveys", but sending bills and reports to the Deputy Surveyor General[11]. Ellis was ordered "to commence active operations as soon as he arrives at Diboora Mookle (now called Dibooragheer)"[12], but he went sick and, writes Jenkins, was granted leave

> to 1st March 1841. ... It being evident he will not be able to return to Assam until...he has recruited his constitution at sea, I...request that another Revenue Surveyor be appointed

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[1] BRC. 17–5–43 (4). [2] from DSG. 20–12–42 ; MRIO. 36 (40–1) ; rev. svy. Upper Assam, 1841–2. [3] BRC. 12–2–45 (35). [4] formerly in mil. service with Marāthas ; 1805–23 trading with Assam from Rangpur, Bengal ; Bhuyan (445, 578). [5] (1803–88), Ben Inf., Ens. 1821 ; 2nd. in comd. Assam LI. 1829–35. [6] *JASB.* VI, 1839 (168, 197–526, 622–3) ; also in pamphlet pub. Bishop's Coll. Press, Calcutta. [7] Chas. Alex. Bruce, bro. to Robt., comdd. gunboat div. in Assam 1824–5 ; trader at Sadiya [III, 218 n.6] ; started tea cultn. with plants from Singpho chiefs ; d. 23–4–71, MI. Tezpur. [8] v. Hannay, *JASB.* VII, 1838 (671–9). [9] BRC. 4–4–39 (54). [10] from DSG. 9–11–39 ; BRC. 7–4–40 (62). [11] Rev Bd. 8–7–40 (118). [12] Dibrugarh, now a prosperous tea-planting centre.

> to the Muttack Survey without delay. In the meantime the establishments have been sent up under Mr. MacDormond, Deputy Revenue Surveyor, to Dibrugarh, and will commence operations, but as Mr. Dormond is without practical experience, I will direct Mr....Thornton to proceed to Dibrugarh...to set the survey at work[1].

A well qualified assistant, Francis Morton, was sent up from Balasore, and held charge of the "Mattack Survey" from 4th February 1841 until the party was broken up and he was discharged on 30th September 1842[2]. Thornton later found Morton's survey of over 600 square miles so faulty that it had to be entirely resurveyed, a task that occupied him for the next three years[3]. One of Morton's maps was a "Sketch of the southern side of the valley of the Eastern Frontier of Assam, exhibiting the route taken by the political agent, Captain Hamilton Vetch, in 1841–42"[4]. It is dated 4th June 1842, and is on $\frac{3}{4}$-inch scale, covering the Lohit River from Dibrugarh to Brahmakhund, and the south bank of Buri Dihing River[5].

METHODS OF SURVEY[6]

It is impossible to give a clear account of revenue surveys in India without the use of Indian terms, which are often puzzling as they vary from one part of the country to another[7] [I : 135 : IV, 177]. A "revenue survey" denotes a measurement or *farmaish*, on which the civil revenue officer may base, or "settle", the revenue or *jama* due from the land so measured. Land held free of rent, by special grant or inheritance, is termed *jagīr* or *lakherāj* [177, 210]. A *khasrah* survey is a measurement of fields and plots, *dāgs* or *dangs*, made by Indian measurers, *amīns* or *mirdhahs*, with bamboo rods, *nals*, or with chains or ropes, *jaribs*. Areas are taken out by simple geometry in *bīghas* or other units. The *amīns* sometimes submitted to the Collector of the district, or *zillah*, or to the "settlement officer", a written tabular statement, or *chittah*, giving the area, name of owner, and other particulars for each plot, sometimes with a *shujrah*, or rough sketch [195 n.1, 229].

The "European" or "professional" survey was carried out by theodolite and chain traverse, arranged in "circuits", and calculated by traverse tables, with areas taken out in acres by "Gale's universal theorem" [III, 148 n.1 ; IV, 232]. The primary task of this survey was an exact survey of the boundaries of "estates", *zamīndaris* or *mahāls*, belonging to an owner or a group of owners, on which the "permanent" or periodic "settlement" was due ; *khās mahāls* were estates owned and managed by Government. In some cases survey was also, or exclusively, made of the boundaries of township or village area, *tāluk* or *mauzah* [206, 227]. The limits of the official administrative subdivisions of the district, *parganas*, *tahsils*, *thānas*, or *tappas*, were recorded as a matter of course, being generally coincident with those of *mahāls* or *mauzahs*.

In some areas *mauzas* and *mahāls* were interlaced or broken into scattered fragments regardless of *pargana* or *zillah* boundaries ; a *mauza* or village might be registered by a name that was quite unknown on the ground.

The professional and *khasrah* surveys were generally arranged by separate *tahsils*, *parganas* or *thānas*, within which all important topographical detail was surveyed, so that district, *tahsil*, *pargana*, or *thāna*, maps could be prepared in due course. This detail was generally taken up by the professional surveyor, but sometimes left to the *amīns*. In some cases the surveyor was responsible for the *khasrah* survey, in others it was left to the civil revenue officer.

Before starting his survey the surveyor obtained from the responsible civil officer a diagram and description, *thakbast* and *misl*, of each boundary and its marks [233 ; pl. 8]. In the lower provinces there were, owing to the permanent settlement, no regular revenue officers such as *kānungos* or *patwaris* [9, 213].

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[1] from Comnr. 16–11–40 ; BRC. 29–12–40.

[2] ib. 10–10–42 (83) ; from DSG. 20–12–42 ; ib. 17–5–43 ; (4).

[3] ib. 17–3–47 (1).

[4] (1804–65) ; Ben. Inf., Ens. 1823 ; M Gen. 1861 ; on service in Assam from 1829 ; DC. Assam, 1852–7.

[5] MRIO. 36 (41).

[6] *v.* pamphlet "on the present system of survey", J. D. Herbert, Calcutta, 1830 [211 n.4, 262].

[7] glossaries Whitworth ; Wilson.

Village maps were as a rule plotted on the scale of 4 inches to a mile, too small to show individual fields [pl. 12]. "Cadastral" surveys on scale 16 inches to a mile, and shewing every field [8, 180–1], were not introduced till much later, though a rough "cadastral" map could be formed by a combination of the *amīn's naksha* or *shujrah* with the surveyor's *mahālwar*, *mauzāhwar*, or *tālukwar* survey of boundaries.

For the survey of Chittagong [195] the Collector asked that the Surveyor should prepare "thannawarree, mouzahwarree, and field maps".

> In the thannawarree map all the mouzahs of the thannah, their relative situations, and their respective boundaries, will be clearly laid down and defined.
>
> In the mouzahwarree map the boundaries of all the villages, the roads, tanks, sites of houses, khals and intersecting nullahs, the jungle and cultivated land, would be exhibited.
>
> In the field map will be recorded each separate field in each mouzah, as defined by the occupants, ... in regular succession of number, and displaying their relative situations, noting whether cultivated or uncultivated, and the area of each. ...
>
> The Surveying Officer shall fix in the centre of each field, and at its extremities, poles marked with numbers—corresponding with the number under which the field is recorded in the field map—to enable the Settling Officer to recognize them with facility. ...
>
> The Settling Officer having obtained from the Surveying Officers the field map, ... will proceed...to each field, from No. 1 to 1,000 or 2,000 as the case may be. He will, in the presence of the occupant of the field measure each individual field ; will record its area in the chittas ; the tenure under which it is at present...held[1] [237–8].

In Sandwīp [193], Hodges found the *tāluk* a smaller unit than the *mauzah* ;

> One of the mouzahs...contains a total area of about 1,000 acres. About one third of this will be deducted for rivers, khals, uncultivated lands, &c., leaving 666 acres of cultivation. This is divided into 49 talooks, some of which are in 5 or 6 divisions, and the whole number of divisions is 139, ... hardly 5 acres to each division. The areas of all these divisions...calculated ...in acres, &c., would then have to be reduced to the nul [rod] measurement. ...
>
> Instead of this I propose to carry on an equally minute survey. ... The interior of all the mouzas and their boundaries will be laid down in separate plans, including every object, ... shewing the cultivations, culturable waste, barren waste, salt works, sites of houses, and tanks, rivers, and khals. The areas...will also be given separately, and thus afford a capital check on the measurement of the native aumeens throughout every mouza. ...
>
> The above plans will be on the revenue survey scale of 4 inches to a mile, and a connected map of the whole will be furnished on half the scale[2].

The Commissioner asked that the detailed survey should be carried out by *amīns* working under the supervision of the civil authorities, and submitting their information in the form of *chittas* ;

> One great point in all...surveys and measurements...is to carry to the occupants of the soil...conviction of the fairness of the measurement record. ... This can only be done by adapting your proceedings to their capacities, and by using their language, ... and recording the information they have been accustomed to [232][3]. ... The natives of these parts know nothing of survey ; know nothing of our mode of calculating areas. ... Their tenures are much more complicated, minute, and intricate, than those of the Western Provinces, where a permanent settlement has never been made. ...
>
> Now the chittah in use in this part of the country records a variety of information which is not provided for in the khusrah used in the Upper Provinces. ... The area and the names of the ryots ; ... bearings and situations ; ... nature of the tenure ; ... talook...the record of the land in the previous measurement. ... I think therefore that the khusrah ought to give place to, or be accompanied by, ... a chittah prepared in the field, and containing the information which local peculiarities may render necessary[4].

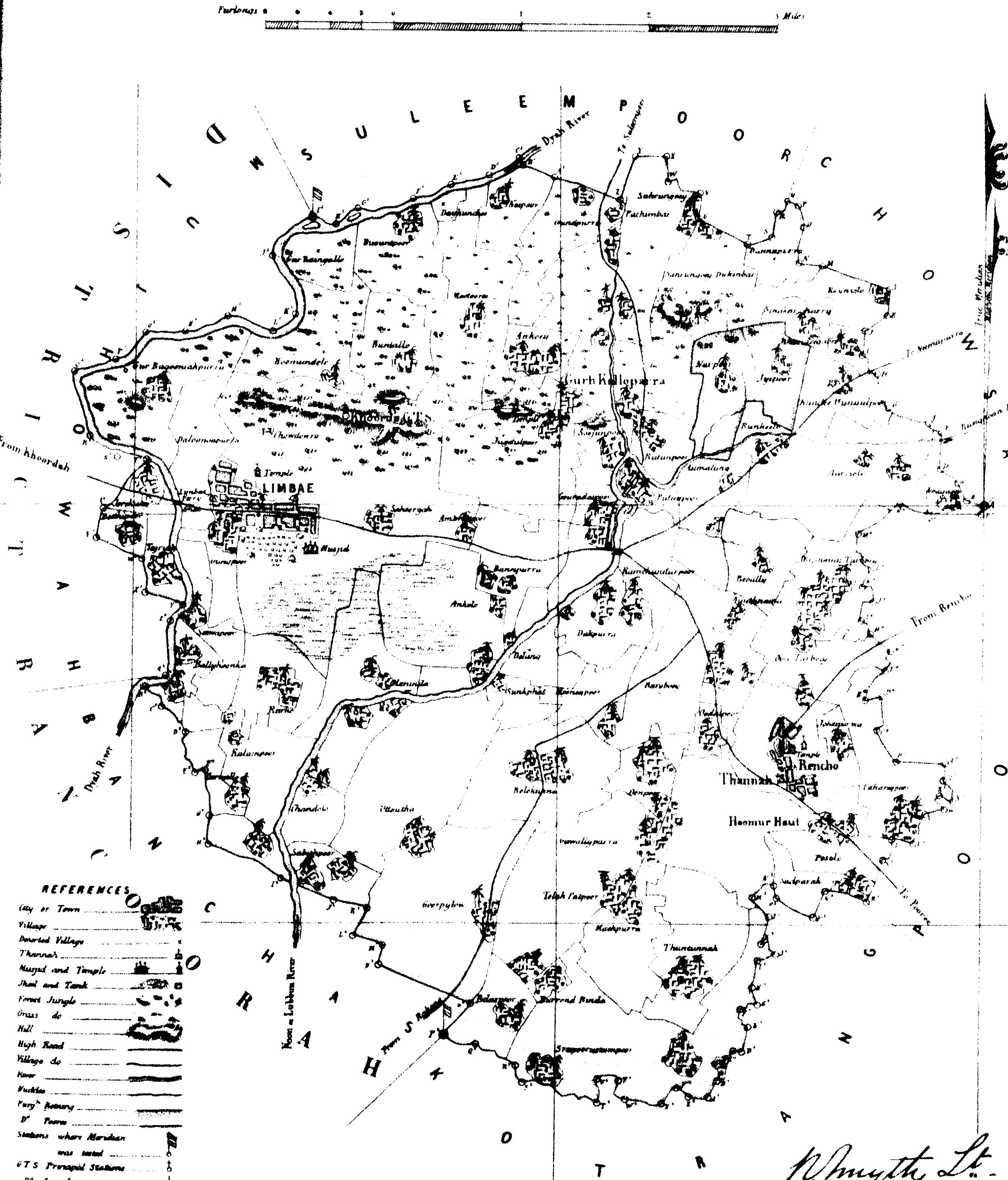
To stimulate local co-operation the Board of Revenue directed that,

> as it is an important object to multiply copies of the village plans, and in the highest degree desirable that the zumeendars should understand the objects of the survey and take an interest in it, ... you will instruct the Surveyors to afford every...facility to proprietors in this respect, ... supplying them with plans of their estates at such moderate cost as may just indemnify Government for the...draftsmen employed[5] [209, 289].

---

[1] BTC. 16–6–34 (29). [2] from Hodges, 2–7–34 ; BTC. 13–10–34 (15). [3] hence the importance of using local units of measure so far as possible ; Hirst (32). [4] from Comnr. 26–8–34 ; BTC. 13–10–34 (26). [5] DDn. 623, 22–5–39.

MAP
of
PURGUNNAH LIMBAE
DISTRICT CUTTACK
Surveyed in
Season 1838 – 39



R. Smyth Lt.

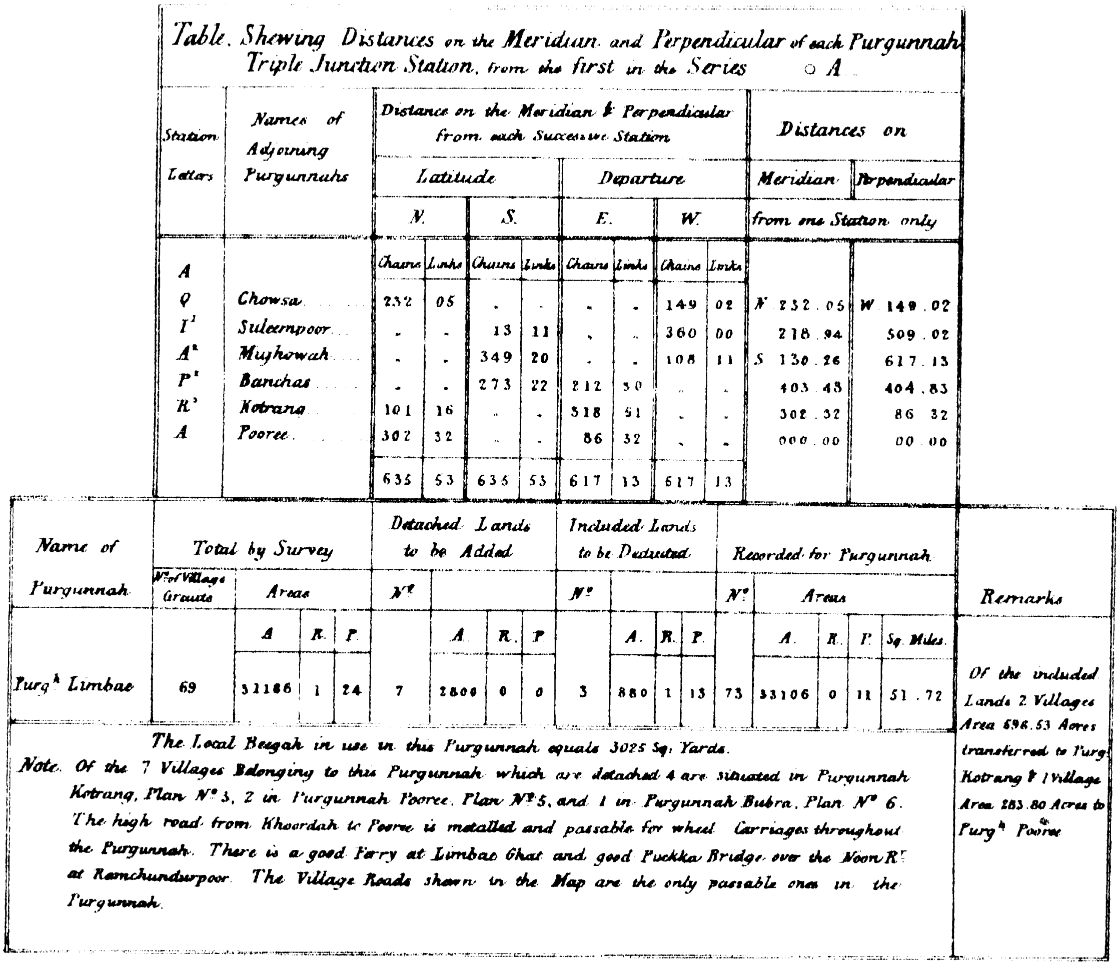


Table. Shewing Distances on the Meridian and Perpendicular of each Purgunnah Triple Junction Station, from the first in the Series ○ A

Station Letters	Names of Adjoining Purgunnahs	Distance on the Meridian & Perpendicular from each Successive Station								Distances on	
		Latitude				Departure				Meridian	Perpendicular
		N.		S.		E.		W.		from one Station only	
		Chains	Links	Chains	Links	Chains	Links	Chains	Links		
A											
Q	Chowsa	232	05	.	.	.	.	149	02	N 232 . 05	W 149 . 02
I^1	Suleempoor	.	.	13	11	.	.	360	00	218 . 94	509 . 02
A^2	Mujhowah	.	.	349	20	.	.	108	11	S 130 . 26	617 . 13
P^1	Banchas	.	.	273	22	212	30	.	.	403 . 43	404 . 83
R^2	Kotrang	101	16	.	.	318	51	.	.	302 . 32	86 32
A	Pooree	302	32	.	.	86	32	.	.	000 . 00	00 . 00
		635	53	635	53	617	13	617	13		

Name of Purgunnah	Total by Survey				Detached Lands to be Added				Included Lands to be Deducted				Recorded for Purgunnah					Remarks
	Nº of Village Circuits	Areas			Nº				Nº				Nº	Areas				
		A	R.	P.		A.	R.	P.		A.	R.	P.		A.	R.	P.	Sq. Miles.	
Purg^h Limbae	69	31186	1	24	7	2800	0	0	3	880	1	13	73	33106	0	11	51 . 72	Of the included Lands 2 Villages Area 596.53 Acres transferred to Purg^h Kotrang & 1 Village Area 283.80 Acres to Purg^h Pooree

The Local Beegah in use in this Purgunnah equals 3025 Sq: Yards.

Note. Of the 7 Villages Belonging to this Purgunnah which are detached 4 are situated in Purgunnah Kotrang, Plan Nº 3, 2 in Purgunnah Pooree. Plan Nº 5, and 1 in Purgunnah Bubra. Plan Nº 6. The high road from Khoordah to Pooree is metalled and passable for wheel Carriages throughout the Purgunnah. There is a good Ferry at Limbae Ghat and good Puckka Bridge over the Noon R^r at Ramchundurpoor. The Village Roads shewn in the Map are the only passable ones in the Purgunnah.

Pargana Map, shewing village boundaries, Revenue Survey, Lower Provinces. Slightly reduced from scale one-inch to a mile [ch. xi].

Adapted from plate X, *Manual of Surveying for India.*

G.T.S. stations are those of South Parasnath Series, to which Smyth connected his survey [ch. v].

Note the villages belonging to neighbouring *parganas*.

The tabular statement here shewn was an essential accessory to the *pargana* plan.

To a questionnaire which Bedford circulated on taking charge [322–3] the replies differed widely from one survey to another.

> 1st. Strength and monthly expense of your present establishment. Does it contain any native surveyers, or admit of being altered or increased with advantage ?
>
> 2nd. Whether operations are scientific only, or include...khusrah or field measurements ?
>
> 3rd. Whether work proceeds on the true or magnetic meridian ?
>
> 4th. If any exterior points be fixed to ensure accuracy of the general outline, either by large circuits, triangulation, or other means.
>
> 5th. What is the estimated extent of country ordered for survey? ... And is it conducted in a connected way through the district, or by detached pergunnahs ?
>
> 6th. If the latter, whether connected lines are surveyed between the detached portions so as to bring the whole into a general map on their true relative position ? ...
>
> 9th. What is the average area of village circuits as surveyed ?
>
> 10th. What is the rate of progress since survey commenced ; ... in square miles ?
>
> 11th. Landmarks. What kind are raised, and how maintained ?
>
> 12th. Power of Deputy Collector for boundary settlements. Whether conferred or otherwise ? or if desired ? ...
>
> 17th. Whether...the village areas [are] found by the Universal Theorem method [232] after proving the work by Traverse ?
>
> 18th. Is there any interior professional survey of cultivation and other items ?[1]

Extracts from Siddons' replies have already been quoted [196], other were given by Thuillier from Sylhet ;

> 1. The whole of the native aumeens (twenty-five in number) work with a Bengalli compass, which was first introduced by Capt. Fisher [III, 148]. ...
>
> 4. Works with a large circuit as well as by triangulation, which I carry on myself, whenever my other occupations allow me. ...
>
> The scale of 4 inches to a British mile has been used for all maps. The mouzawarry maps have been furnished to the Collector on this scale, but the pergunnah plans were reduced to the scale of 2 inches to a mile. ...
>
> 11. There are no landmarks or boundaries of any sort in the country. All my attempts to induce the inhabitants to make them have proved ineffectual. The lands of one mouza are mixed up with another several miles off. ...
>
> 17. Gunter's chains only are used for the survey, and every area is found by the Universal Theorem after the work has been prepared by traverse. ...
>
> 18. The interior of every mouza is surveyed with the prismatic compass and chain, and everything of note laid down[2].

In a later letter Thuillier commends the excellent work of the Sylhet *amīns* whom Fisher had trained to survey with compass and rod,

> amply sufficient for all interior details for the professional mouzawarry maps. ... There will not be any difficulty...in filling in my maps with the proportional compasses, & the saving will be very great, as it will enable my assistants to proceed at least as fast again in their scientific survey. ... By constant attention I have brought the ameens into very fair order, & I seldom find the smallest nullah...or other remarkable object omitted, but everything is laid down, & with an accuracy which is almost surprising[3] [195, 200].

On this the Revenue Board commented that

> the khusreh maps, instead of being mere rough indexes like those of the N.W. surveys, give the true size, shape, and position of every plot, and being copied on English paper will form a permanent record of the exact locality and area of every talook, however scattered or minute, on the Collector' roll. This accounts for the high cost of the khusreh compared with the professional work in Lieutenant Thuillier's estimate[4].

We have elsewhere described the difficulties presented to the revenue surveyors by the variation of Indian measures both linear and superficial [III, 163–4 ; IV, 147, 232]. The resulting adoption of the Gunter's chain, the yard, and the acre as in the Western Provinces, was not regularly followed in the Bengal districts, and, though the chain was used for the professional survey, the surveyors had to struggle with a multitude of Indian measures.

In Darrang, Assam, the standard measuring rod, or *tar*, was "seven inches longer than that used in the other Divisions of the province which corresponds with the one used in the Revenue Survey". In Cuttack, Fraser obtained sanction to introduce a measuring rod that "would render the beegah equal to an English statute acre[1], and, when the Settlement Officer in Hijli asked why a rod of 5 *hāths* was being used in one *zamīndari* and one of 5¼ *hāths* in another, Mathison replied that

---

[1] from DSG. 14–12–37 ; BRC. 12–6–38 (133). [2] DLR. 37/61 (15) ; 29–12–37. [3] from Thuillier, 23–3–38. [4] from Rev Bd. 23–7–42 ; BRC. 1–8–42 (31).

> Lieutt. Egerton...called on the zemindars to produce chokas for their respective estates. The Jellamootah zemindar immediately sent one bearing his own seal by the hand of an accredited mookhtear which, on being measured by Lieut. Egerton, was found to be 8 ft. 6·2 inches, called 5 haths, and recorded accordingly in Lieutt. Egerton's own handwriting.
>
> For the other estate the zemindar took no notice, and Egerton applied to the Collectorate and received a choka with the seal of Mr. Wyatt[2], also called 5 haths, but measuring 7 feet 10·6 inches [III, 163–5 ; IV, 190 n.6][3].

Mathison persuaded the Settlement Officer that chains were far better than the wooden *nals* or rods used by the *khasrah amīns*, and had 200 made up at Rs. 3–8 each ; "each chain to be half a beegah, or seventy feet in length", as convenient as the Gunter's 66-foot chains used in the western provinces. Bedford claimed later that the substitution of the chain for the *nal* had greatly increased the outturn.

Siddons writes from Chittagong ;

> The jureeb is a bamboo null, nominally 8 haths, or cubits, long. ... I...was furnished by the Collector with sealed copies of the standard nulls, the shortest that of the year 1126 MS. [1765 A.D.], and the longest that of 1162 MS. [1801 A.D.]. The former I found to be 12 feet 1½ inches, and the latter measured by the hath of the then Collector, was 12 feet 6½ inches. ...
>
> [Square units] — 4 Koorees = 1 Gunda — 80 Koorees = 20 Gundas = 1 Kannee — 1280 Koorees = 320 Gundas = 16 Kannees = 1 Droon. ...
>
> The...village is supposed to be measured by the amins, but...there is much guesswork in every detail. In some cases...correctness...is out of the question, and...a good round number of droons for jungle...swells their account and looks well in a report of progress[4].

Boileau writes later that

> there is a tendency to error when an inexperienced...native uses the null. This null is a bamboo rod about 12 feet in length, and is guided by the unaided eye of one man who, holding the rod by the centre, and assuming the irregular bunds of a field, or fields, as perfectly straight and rectangular, turns his rod over his wrist and measures beyond or within the true dimensions, according as the zamindar is favourable or otherwise. ...
>
> A strict purtal is very requisite, and ought invariably to be undertaken by the party conducting...the null measurement. A ten per cent deduction from my survey area...is far from an excessive one in order to obtain a just approximation to my jurroeb area[5].

The Collector of Sylhet records that in 1785 there were 12 *hāths* to a *nal* ;

> I have also taken the evidence of Dial Kishen, son of Jeeoon Kishen, dusteedar, whose office it was to give the length of the null at that time, and who now holds the original brass rod prepared by his great-great-grandfather, Joy Kishen Chand, dusteedar, from one brought from Delhi, which rod agrees in length with the iron one in this office prepared from it[6].

From Cāchār Thuillier writes that for his *khasrah* measurement he asked

> the Superintendent for a standard length null, ... which he gave me of a length exactly 24 feet 11 7/8 inches, but this was determined merely by the rough estimate of a person's hand, there being no record...in his office shewing what the proper length of the null might be. ...
>
> In Jynteah the local khoolbah is equal to 23,633 square yards, and the Cachar koolbah is said to be the same, but with the above standard I am not able to make more than 23,313 sq. yards out of it [199 n.6]. Of course it is necessary for me to calculate according to the actual rod with which my ameens carry on their measurements, otherwise the two areas (of professional and khusreh) cannot approximate[7].

The professional survey followed standard principles [III, 146–8, 158–63 ; IV, 229, 232]. Bedford, Wroughton, and Brown of the upper provinces, Thuillier and Smyth of the lower, had qualifications that would hardly be challenged in modern times, and applied these principles to the ever changing conditions with constant watchfulness. The following are two orders issued by Bedford on the subject of main circuits, bringing procedure of the lower provinces into line with that already operating in the upper provinces.

---

[1] 1 bīgha = 1 sq. *jarib* of 80 *hāth* [I : 135]. [2] Thos. Wyatt ; BCS. 1818 ; Collr. Hijli 1828–39. [3] DLR. 37/47 (20), 22 to 9–6–40. [4] ib. 36/42 (19), 9–1–38. [5] ib. 36/43 (167), 21–5–41. [6] DLR. 37/60 (80), 31–3–42. [7] from Thuillier, 15–1–42 ; BRC. 12–2–42 (120) ; DLR. 37/60 (228), 25–11–43.

Circular Order No. 448 of 14th June 1838. Main Circuit System is to be adopted from the commencement of next season, Each main circuit to be proved by traverse, and filled in on lithographed forms. ... The main circuit stations are to be introduced into the pergunnah maps, ... and the pergunnah boundary stations will be the same as those of the contiguous main circuits. The area of each main circuit is to be as large as local circumstances will allow, but...never less than from 30 to 50 square miles.

Circular Order No. 504 of 23rd July 1840. It is absolutely requisite that the interior boundaries of the comprised villages should in no instance be commenced until their respective main circuits are closed and proved.

From 1838 a start had been made at Allahābād on the reproduction of revenue survey maps of the North-Western Provinces by means of lithography [288–9], and in 1840 a similar start was made in the lower provinces. The Commissioner at Chittagong had received a package of maps "in so very damaged a state, though carefully packed in tin" [91, 195], that he asked that Siddons should be allowed 12 additional draughtsmen to make triplicate copies by hand of some 950 village maps, at a possible cost of Rs. 5,700. The Board of Revenue calculated that

by...lithography the...copies may be furnished at very much less expense. ... The difference of expense between printing ten and 100 copies would...be very trifling, and the Board conceive that from six to ten copies are as many as could be required[1].

On this Government authorized the lithography of the Chittagong village plans, 50 copies each at Rs. 24 per 100. This was eventually extended to the printing of 5 copies each of *pargana* maps of all lower province districts [313].

OUTTURNS & COST RATES

After Bedford's move to Calcutta he submitted full annual progress reports for each one of the parties working under his control. He took pains to account for variations from district to district, and from season to season, and to shew why the surveys in Lower Bengal were so very much more expensive than in the North-West [179]. He gives particulars for the following surveys from their commencement to their conclusion in 1842[2] [234] ;

	Area Surveyed Sq. miles	Cost Rupees	Rate per Square mile	Total Cost, including *khasrah*
Jaintia ...	539·34	35, 643	Rs. 66– 1–4	43, 047
Balasore ...	1, 846·27	... 77, 505	... 41–15–7	... 1, 08, 046
Cuttack ...	3, 093·48	... 76, 903	... 24–10–6	... 1, 08, 487
Puri ...	2, 694·16	... 61, 050	... 22–10–6	... 72, 588
Tippera ...	1, 611·14	... 88, 728	... 55– 1–2	... 91, 912
Hijli & Tamluk ...	1, 357·26	... 51, 500	... 37–15–1	... 70, 052
	11, 141·65	3, 91, 331	35– 2–4	4, 95, 052

The following figures include Chittagong in addition to those above[3].

Total Area, sq. m. 11,834¾	Cost of Professional Survey ...	Rs. 4,08,663
	,, *khasrah* ,, ...	,, 1,10,425

Cost rate of Professional Survey, Rs. 34–8–6 per square mile; of *khasrah*, Rs. 30–10–10.

Apart from variations in the conditions of work and changes in staff, there had been considerable increase of outturn and reduction of cost rates during the last five years of the survey from the experience gained, and it was unfortunate that these surveys could not have been maintained a few years longer so that the acquired skill might have been employed for the good of the State [182].

---

[1] from Rev Bd., LP. 15–4–40 ; BRC. 28–4–40 (15). [2] B to CD. 20–11–43 (8). [3] BRC. 17–5–43 (4) ; cf. DSG., 2–4–59, *Ben Rev LP.* 1857–8.

CHAPTER XIII

REVENUE SURVEYS: NORTH-WESTERN PROVINCES

Reorganization, 1830–3 — General Narrative, 1833–42 — Demand for Speed, 1837 — DISTRICT SURVEYS: *Delhi and North-West — Meerut to Mussoorie — Rohilkhand — Agra & Central Doāb — Gorakhpur & Azamgarh — Allahābād & Cawnpore — Bundelkhand — Benares & Mirzāpur — Surveys closed down, 1841–2 — Practical Details — Outturn & Cost rates.*

DURING 1830 the Governor General, Lord William Bentinck, took up seriously the problem of speeding up the revenue settlements of the western districts, with the primary purpose of increasing the yield of land revenue[1]. Though he recognized that reliable professional surveys were essential, he regarded those already in progress as quite useless for the purpose. In fact, he told Everest, "he had thoughts of abolishing them altogether, seeing that they were never used by the Collectors"[2]. He was ready, however, to consider reports and suggestions from surveyors and civilians. His most trusted adviser in these matters was Merttins Bird, Commissioner of Revenue Gorakhpur Division from 1829, who had recently started on the settlement of his districts[3].

> I commenced operations at Gorruckpore. The late Lord William Bentinck having visited that district the following year communicated fully with me on my plans, and by his command I maintained a constant correspondence with him on the subject. The result was his calling me...to the office in which the superintendence of the settlements of the North West Provinces has devolved principally upon me[4].

In 1831 Bird was appointed to act on the new Sadr Board of Revenue that was established at Allahābād[5], and for the next ten years took a leading part in the new settlement of revenues, and shaping the surveys on which it was based.

Hodgson had warned Government that the survey would be slow and expensive and, as he insisted on a high standard of accuracy, it definitely proved so [III, 161 ; IV, 6–7]. The surveyors would not admit that the survey was unduly extravagant or slow for what it provided, and Bedford claimed that expectations had by no means been disappointed, either as to expense or general progress. If greater outturn had been desired the surveyors should have been informed.

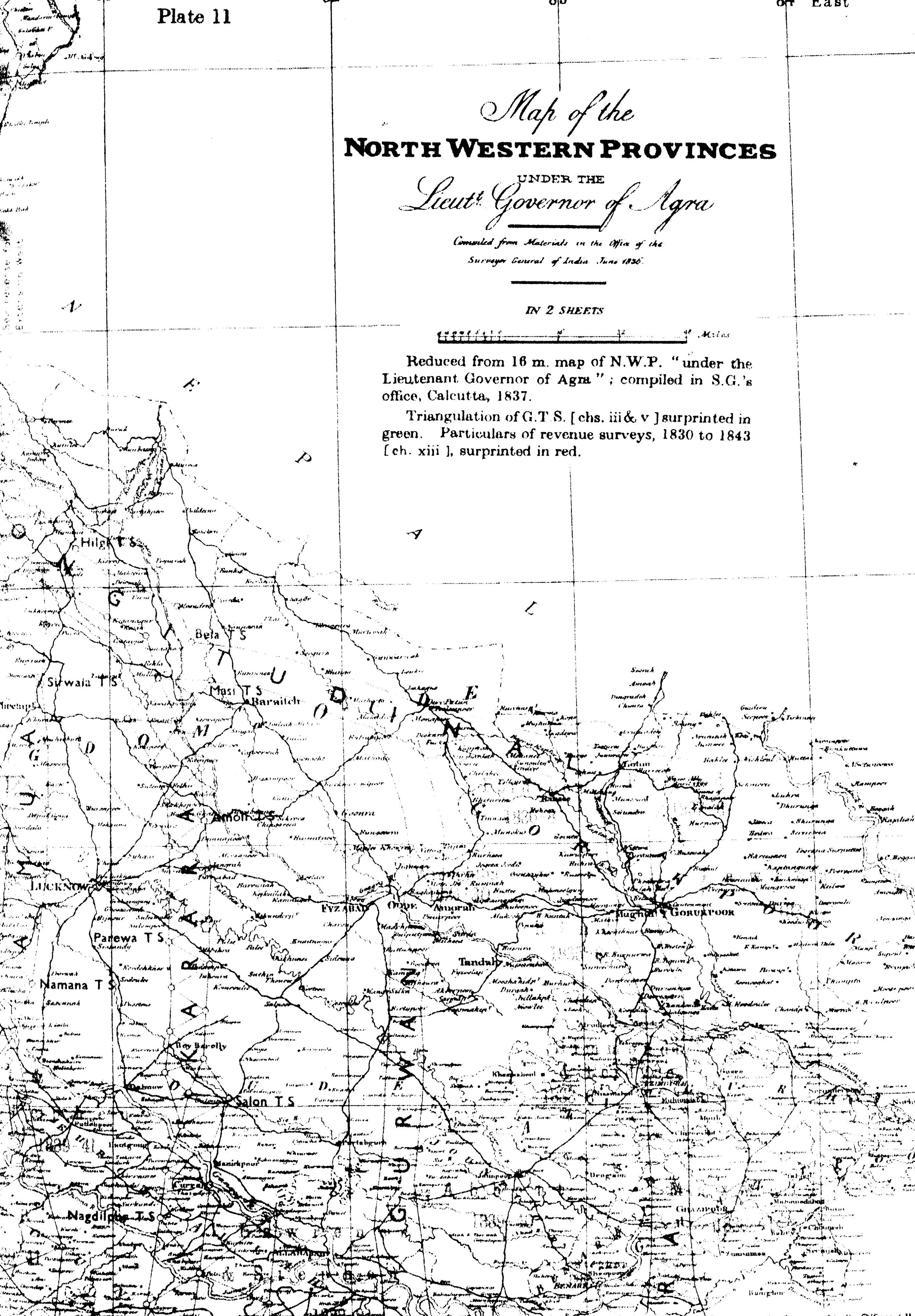
Outturn for each survey had averaged less than 300 miles a season, whilst the average cost-rate for the Sahaswān survey for the past four seasons was Rs. 121 per square mile, covering full details of

> 1st. Boundary of each village or mauzah, ... with all conspicuous objects on or near it.
> 2nd. Lands under cultivation. ...
> 4th. Jheels, jungles, rivers, nullahs, ravines, and large tracts of...unculturable land.
> 5th. ...Lakheraj land [177, 205]. 6th. Jageer or service land [rent-free].
>
> The above are surveyed with different instruments, more or less accurate, but the whole on European principles.
>
> 7th. Return of soils estimated from survey notes made on each line, and from comparison of the mushahut report [212 n.3]. ...
>
> 8th. Census of each village, with return of artisans and castes, &c., ascertained from the village officers, and checked by enquiry on the spot.
>
> **Minute as the above information appears, the average progress is still far above the estimate on which these laborious surveys were undertaken [III, 142]. ... Village areas are calculated by a process which approaches to mathematical accuracy, ... by the traverse of each village, and calculation of the areas by the Universal Theorem [III, 148 ; IV, 232].**

---

[1] He is said to have converted deficit of 1 m. pounds in 1829 to surplus of 2 m. by 1833; Boulger (61). [2] DDn. 283 (162–5), 29–9–32. [3] on the lines of Regn. VII of 1822 [III, 159 n.1]. [4] *Rev Svy. India*, 1853 (127). [5] offg. from 29–11–31; subst. from 28–7–34 till ret. 28–2–42.

Plate 11



Map of the

NORTH WESTERN PROVINCES

UNDER THE

Lieut. Governor of Agra

Compiled from Materials in the Office of the
Surveyor General of India June 1836.

IN 2 SHEETS

Reduced from 16 m. map of N.W.P. "under the Lieutenant Governor of Agra"; compiled in S.G.'s office, Calcutta, 1837.

Triangulation of G.T.S. [chs. iii & v] surprinted in green. Particulars of revenue surveys, 1830 to 1843 [ch. xiii], surprinted in red.

Printed at the Survey of India Offices (H.

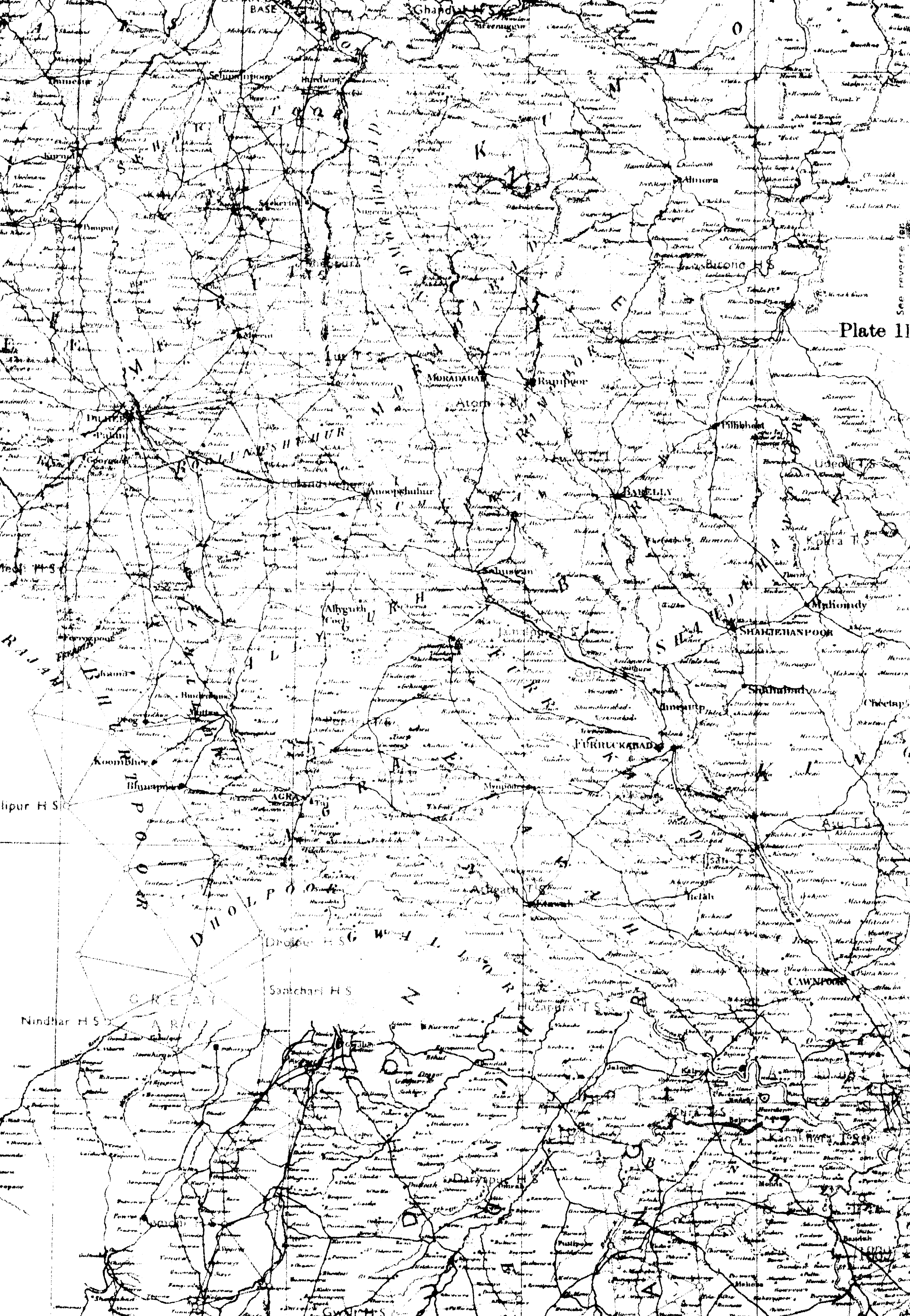


Plate 11

See reverse for

Bedford discussed various ways by which expense might be reduced, such as the abandonment of the rigorous traversing of every village boundary, and restricting traverse lines to "tracts containing from twenty to thirty square miles". He further pointed out that much of the Surveyor's time was spent on the settling or recording of boundary disputes [III, 154][1].

Like Bedford, William Brown had by the use of Indian surveyors reduced his cost-rate to an anna an acre, or Rs. 40 a square mile [III, 161, 389-90] ;

> The survey is now thought of no use. ... If it is useless, it is not our fault ; everything that had been pointed out from time to time to us has been accomplished, and nothing left undone on our parts to carry into effect the orders of Government. ...
>
> The Collectors, instead of acting in concert with us, as was first intended, have generally been found to have business is another corner of this district, and since I have been in the survey department (8 years)...we have worked away by ourselves, attracting no notice and giving no trouble, saving the adjustment of boundaries.
>
> When the surveys first commenced, it was expected the Collectors would keep pace with them. I have now 1,700 villages surveyed under four different Collectors, a tithe of which are not settled.

The revenue staff thought the survey too precise and detailed, though a valuable check. They preferred to make their assessments in the old-fashioned way, leaving their low-paid officials to bargain with the land-holders.

> The survey...has been working...quickly in proportion to the...settlements. ... Since the survey commenced many of the native measurements have (except in the quantity of cultivation) come very near our total areas, but this is entirely owing to the check of the survey, for...mirdhas and ameens are on the alert.

He deprecated the system under which the Collector's staff not only assessed the revenue, but acted as both "prosecutors and judges in all revenue matters", and suggested that "an entirely separate establishment under an assessor of revenue" be employed for the purpose, and also for adjudicating on boundary disputes, thus foreshadowing the introduction of Settlement Officers. He proposed a closer liaison with the Collector's staff, giving the Surveyor control of the *khasrah* as well as of the professional survey but, like Bedford, said that "a much more expeditious and cheaper survey...can only...be effected by giving up part of the present correctness, and particulars"[2].

George Fraser made equally constructive proposals, emphasising the value of uniting professional and *khasrah* survey under one control, with the *amīns*' field survey preceding the professional.

The Board of Revenue admitted that the professional surveys

> have been little used by the Revenue officers in their settlement operations. ... There can be no question that the surveys, ... marking in a way not to be disputed the boundaries of estates, and exhibiting the precise area of the villages or other divisions, ... are of considerable utility, but whether the attainment of such objects alone will justify the continuance of the surveys must depend...on the cost at which they are effected[3].

Quoting his pamphlet of 1830 [205 n.6, 262], Herbert made the bold proposal to have the survey of fields carried out by planetable by a native staff specially trained, and working under the professional surveyor [186]. This met with no support as the planetable provided no numerical record of geometric measurements on which revenue settlement had been based from time immemorial[4].

Brown now put forward firm and practical proposals for cutting down the less essential tasks of the surveyors ;

> It has been very generally expressed that the expensive maps...furnished by the survey are of little or no use. All that the Collector looks to is for information...of the cultivation and culturable land, and seldom casts his eye on the map except to admire its execution, or regret the needless expence.
>
> The General Map [¼-inch *pargana*], the most gaudy and costly of all, has not even the advantage of being seen, but is locked up in the archives of the Surveyor General[5], and from first to last is never in the hands of a Revenue Officer [pl. 13].

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[1] from Bedford 24-2-31 ; BRC. 28-6-31 (32). [2] from Brown, 10 & 25 March 1831 ; BTC. 28-6-31 (33, 37). [3] from Rev Bd. Simla, 25-5-31 ; BTC. 27-12-32 (30). [4] No copy of Herbert's pamphlet has been found ; from DSG. 18-6-31 ; BTC. 28-6-31. [5] still safely preserved in 1950 ; having provided most valuable geographical infn., MRIO. folios 1-20.

The Geographical Map on a scale of 4 miles to an inch is equally useless, altho' a great deal of labour is necessary for its compilation, yet on this small scale there is not room for more than one village in four without rendering it unintelligible by being crowded [pl. 9].

The Civil Servants have universally complained of the waste of time in the statistical and area tables. ... These tables are constructed and copied either by the Surveyor, his assistants, or sub-assistants [pls. 10, 12]. The expense...is enormous. ... All that they seem to require from our information is the quantity of land under tillage—fit for tillage—and barren—with a description of the different soils. The rest is considered superfluous. ... I...recommend that the present statistical and area tables be discontinued. ...

The village maps are a faithful transcript from the field books, and...may be exceedingly useful, both in the Revenue and Judicial departments, ... and ought...to be continued [pl. 12].

The General Map may...be dispensed with ; ... its use in the revenue line is out of the question. In order, however, to...enable a General Map to be formed...at any time, ... I propose that a copy of the table of the co-ordinates of the tokha stations (the point where three or more village lands meet)...be forwarded annually for record in the Surveyor General's office. ...

A Collector informed me that, notwithstanding the voluminous papers he had to prepare... with every settlement, yet the information he derived from the survey was the only satisfaction in his own mind. ... The survey will no doubt be of great use as a record of the boundaries of estates, ... which is much required. ... In districts where the surveyors have been at work, the ameens...are on the alert, and their areas often correspond very well with ours[1].

In forwarding Brown's report Herbert comments that he

has proved himself equally able as he is zealous, and, having uniformly succeeded every year in reducing the expences of his survey, ... I should be loth by any chance to hazard his labours. ... The expence of the survey has been reduced. ... From Rs. 41-5-8 the square mile, it has fallen to Rs. 33-6-5, ... but one-third of the expence of 1826-7[2].

As a result of his enquiries, the Governor General drafted an important minute on the subject of revenue assessments and land surveys ; " I have long and anxiously deliberated on the state of our revenue affairs, ... and since my departure from the Presidency I have...taken a part in several interesting discussions".

He discussed the proportion of the crop that Government should collect as revenue, which in the past had varied from one sixth to one half. Both Akbar and Munro had assumed one third as a fair rate, subject to remissions in bad times [I: 133 ; II, 181-3]. Bentinck discussed the *zamīndari* system,

the ruling authority...assigning to one rich and powerful individual a tract of country, or a number of estates, in which such individual was...constituted...owner of the Government share of the produce of the soil (or the rent), on condition of his paying a certain tribute to the State—becoming responsible for the police of the tract—...and devoting himself to the welfare and prosperity of the different estates, the improvement of which was to be a source of wealth to himself.

The objects of such an assignment may have been various ; 1st. To ensure a certain and unfluctuating revenue, and at the same time to avoid the...fraud to which the State was liable under a system of khas management [205].

2nd. To secure the efficient support of rich and powerful individuals.

3rdly. ... Rewarding faithful servants, or attaching to...the State men who would otherwise have been dangerous and troublesome subjects. ... 5thly. As a mode of recovering arrears of revenue, ... otherwise hopeless, or of bringing again into cultivation tracts of country laid waste by famine, war, or misrule.

He strongly favoured an exact survey conducted by a professional surveyor ;

A minute map of tenures, and a more particular record, ... would...be more accurately... obtained by...an establishment superintended by the professional surveyor than by the rude process hitherto adopted. The maps furnished by the musahat establishments[3] are constructed on so unscientific a principle as to be almost useless. Those furnished by instructed surveyors would be neat and accurate, and the register of fields and all particulars regarding them could proceed simultaneously with the map. ...

It should be conducted by a professional officer, who in all matters of local interest should be under the immediate orders of the Revenue Commissioner. The Surveying Officer should survey and map the total area, and record in the aggregate the proportion of cultivated, culturable, and waste, and also the remarkable features of each estate.

---

[1] from Brown, 2-8-31 ; BTC. 27-12-32 (30). [2] from Herbert, 17-8-31 ; ib. (29). [3] *masahat* = measurement of land.

> The Surveying Officer should complete one pergunnah before proceeding to another, furnishing a record of the area, and maps of each village and of the pergunnah, when finished. ... Boundaries...to be settled by the tuhseeldar and native establishment.

The *khasrah* survey and the collection of information required for settlement were to follow, being carried out by *patwāris* and *kānungos* working under the *tahsildar* [9, 205] and accepting the surveyor's gross areas.

> With a view to...securing despatch, economy, and uniformity, ... it is my intention to require...all [surveyors] to proceed to Allahabad in the course of the present season, to consult with the Sudder Board and the Revenue Surveyor General[1] as to the plan of future operations. I shall also request the services of Captain Herbert on this occasion[2].

The conference sat at Allahābād on the 21st, 22nd, and 23rd of January 1833 with the Governor General presiding. Besides the surveyors were the two members of the Board of Revenue and their Secretary, three Commissioners of Revenue, and the revenue officers of Allahābād District[3]. Bedford recorded the minutes and was responsible to the Board of Revenue for implementing them.

> The result...has not been to alter in any material points the sentiments of his Lordship as recorded in his minute of 26th September 1832.
>
> The professional surveyors have assured His Lordship that they can furnish scientific maps, ... accompanied by field registers in detail, ... at a less expense than has been heretofore incurred ...by two distinct departments.
>
> The Revenue Surveyor General is engaged in the preparation of a report which will furnish... the mode of survey to be adopted, the nature and expense of the parties to be employed, and the quality and description of work to be required[4].

The Indian establishment was substantially increased and was to cost nearly as much as the European staff [234, 346], and there were many other changes ;

> The professional surveys are now to be extended to ryuttwar holdings [II, 180–1], and to be executed on European principles by natives properly instructed, whose work is to be superintended and verified by the Revenue Surveyors. ...
>
> Each Surveyor will be able to give the return of 1,000 square miles yearly ; averaging a little above 28 rupees per square mile. ...
>
> The only returns...required by the civil authority are a plan of each village with a khusreh exhibiting the area of each holding, its proper relative situation, and the name of the cultivator, ... or...a number by which it may be recognized. Also a concise statistical record. ...
>
> Returns to the Superintendent of Revenue Surveys :—A table of co-ordinates—a geographical map, 4 miles to an inch—general result of the survey as in Form No. 2.
>
> Each Village is to be proved by traverse, and the area to be calculated as at present by the Universal Theorem [III, 148 ; IV, 232]. These tables, with the original plans, to be forwarded to the Superintendent for office record[5].

Specimens of field map and *khasrah* from Wroughton's survey of Muttra received formal approval[6] [222]. Commissioners were directed to have all boundaries marked before the commencement of each *pargana* survey.

> The Collector shall...furnish any information sought by the Revenue Surveyor as to the progress making in the adjustment of boundaries, and the Surveying Officer will use his own discretion as to the time at which he shall commence his survey.
>
> When the survey is commenced upon, the Collector will direct the tehsildar to depute a peishkar, or other...officer, to remain in attendance on the survey...to see that the zemindars, putwarees, and other village officers are at their posts, and that every facility is afforded to the survey operations [178]. ...
>
> It will be the duty of the tehsildar to see that the village putwarries prepare a counterpart khusreh of the field measurements, and...every evening bring up...the work of the day. ...
>
> The survey maps, field maps and khusrehs, will be furnished to the Collector as they are prepared, and it will be the immediate duty of...his tehsildar...to fill up without delay the remaining columns in the khusreh. ... After receiving the above record, and comparing it with ...his own records, the Collector shall...fix the Government juma on the mouza[7].

Lithographed copies of instructions with specimens of maps and forms were distributed to all concerned. "The direction and control of the surveys and settlements, the selection of the districts in which they are to proceed, and the direction of the arrangements", rested with the Board of Revenue[1].

---

[1] Bedford, DSG. & Supt. of Rev. Svy. [2] now Astr. at Lucknow ; GG.'s minute, 26–9–32 ; BTC. 27–12–32. [3] Bentinck & his Sec. Macnaghten ; Fane, Bird, & Deeds, of Rev. Bd. ; Macsween, Tilghman, Comnrs., &c. [4] from Sec. to GG. 24–1–33 ; BTC. 8–3–33 (63). [5] from DSG. 23–1–33 ; BTC. 20–5–33. [6] from Rev Bd. 21–5–33 ; BRC. 9–9–33 (19). [7] from Rev Bd. WP. May 1833 ; BTC. 9–9–33 (20).

Much abuse has been showered on this Conference for introducing a system that sacrificed good survey for the sake of speed, but though there were undoubted faults in the new procedure it went a long way to meet the urgent needs of the administration and to provide a settlement of revenues within reasonable time. This could never have been effected by the laborious surveys now abandoned.

There was nothing intrinsically wrong in putting the traverse control and the field surveys under the professional surveyor, but the trouble lay in the insistence of a high rate of speed from the beginning, before adequate staff could be properly trained. Young military officers were given charge of large parties without having served adequate apprenticeship. Assistants and sub-assistants were recruited hastily and sent on field work with little training, and there was little chance of building up a trustworthy staff of Indian surveyors trained on European methods and subject to strict control [216].

It might have worked if surveyors had been allowed to go slow to begin with, but from the very beginning the Board of Revenue—led by Merttins Bird—insisted on speed, and yet more speed. There were, certainly, Revenue Officers who appreciated accuracy and precision, and were horrified at the untrustworthy data they were provided with, and would have given anything for an accurate cadastral survey as had been dreamed of by the Commissioner of Chittagong [180–1]. On the other hand no revenue officer had any need for the correct geographical map that the Bengal surveyors had always insisted on. The Bombay system probably served the revenue purpose best, leaving the surveys without any sort of geographical control, and concentrating on a sufficiently correct plan of the village and its fields.

Markham thus expresses the views of the professional surveyor ;

> The topographical details of these Revenue Surveys were tolerably well executed until 1834, when a conference was held at Allahabad. ... The great object was to get the surveys done, in order to commence a new system of revenue settlement. A new plan was therefore adopted, introducing economy and rapidity, and sacrificing quality for quantity. The maps were only required to delineate village boundaries and sites, with rough outlines of roads and the course of rivers, and were mere skeleton sketches.
>
> They preceded the Great Trigonometrical Survey, and thus proper connection was not in the first instance established between the two operations[2] [218, 288–90].

GENERAL NARRATIVE[3], 1833–42

The first requirements for the expansion of the surveys were the recruitment and training of new officers, assistants and junior technical staff, and equipment. Operations followed no regular plan. New parties were raised, and old parties moved from district to district at the shortest of notice, as demands from local settlement officers reached the Board of Revenue. Of the four parties existing in 1833, Brown was employed in Meerut and Sahāranpur, the upper *doāb*—Birnie Browne in north Morādābād, Fraser in Bareilly, both in Rohilkhand—and Simmonds in Delhi. The number rose to seven in 1836 and nine by the end of that year [362].

The immediate changes were the recall of Wroughton to take up survey in Agra and Muttra, the transfer of Simmonds and his party to Azamgarh, and the appointment of Lawrence and Rind. Lawrence took charge of the Morādābād survey during Browne's absence on leave, and then raised a new party for Farrukhābād [pl. 12]. Rind joined Fraser as assistant at Bareilly.

Fordyce, another Artillery subaltern, was posted to Simmonds' party early in 1834, and took over charge when Simmonds resigned a year later. To meet Thomason's urge for greater outturn, Robert Terranneau, the first uncovenanted

---

[1] BTC. 9-9-33 (39). [2] Markham (98). [3] see plates 3, 11, 23; list of districts [287].

Scale 4 inches to a mile

DISTRICT MORADABAD

ضلع مرادآباد

Detail of Superficial Contents	Acres	Beegahs
Cultivation including fallow	556 ¼	891 . 10
Lately thrown out of D°		
Fit for Cultivation	7½	12 . 4
Barren Waste, &c	218	347 . 15
Total Area	782 ¼	1251 . 13

Houses		Wells			Number of Acres Watered by a Pucka and by a Kucha Well
Pucka	Kucha	Pucka	Kucha	Depth of Water	
2	1100	2	27	Cubits 30	
1102		29			
General Caste of Inhabitants		Pucka Well Costs Rupees 250		Feet 455	By Pucka 6 Acres and Kucha 2½ Acres
Hindoos and Mahomedans		Kucha Well Costs 8 Rupees and lasts 4 Years		Water Sweet	Local Beegahs of an Acre
Number of Ploughs					
100					·625

Remarks	
Description of Land under Tillage	Puc Beeg
Sugar Cane Irrigated Land	14
Unirrigated Land	876
Land uncultivated for last Year	0
Description of Barren Waste	
Site of Village, Roads, Jheels, Topes N.B. 26 Beegahs of Jheel Produce Singarahs	347
Description of Land fit for Tillage Bhoor and Bhoor onwar	12

Surveyed in March 1834

The Local Beegah Contains Square Yards 3025.	Scale { 20 Gunter's Chains or ¼ of a Mile to the } Inch	N° of Missil furnished by Settlement Officer	175	N° of Mouzas in Settlement Officer's List.	3

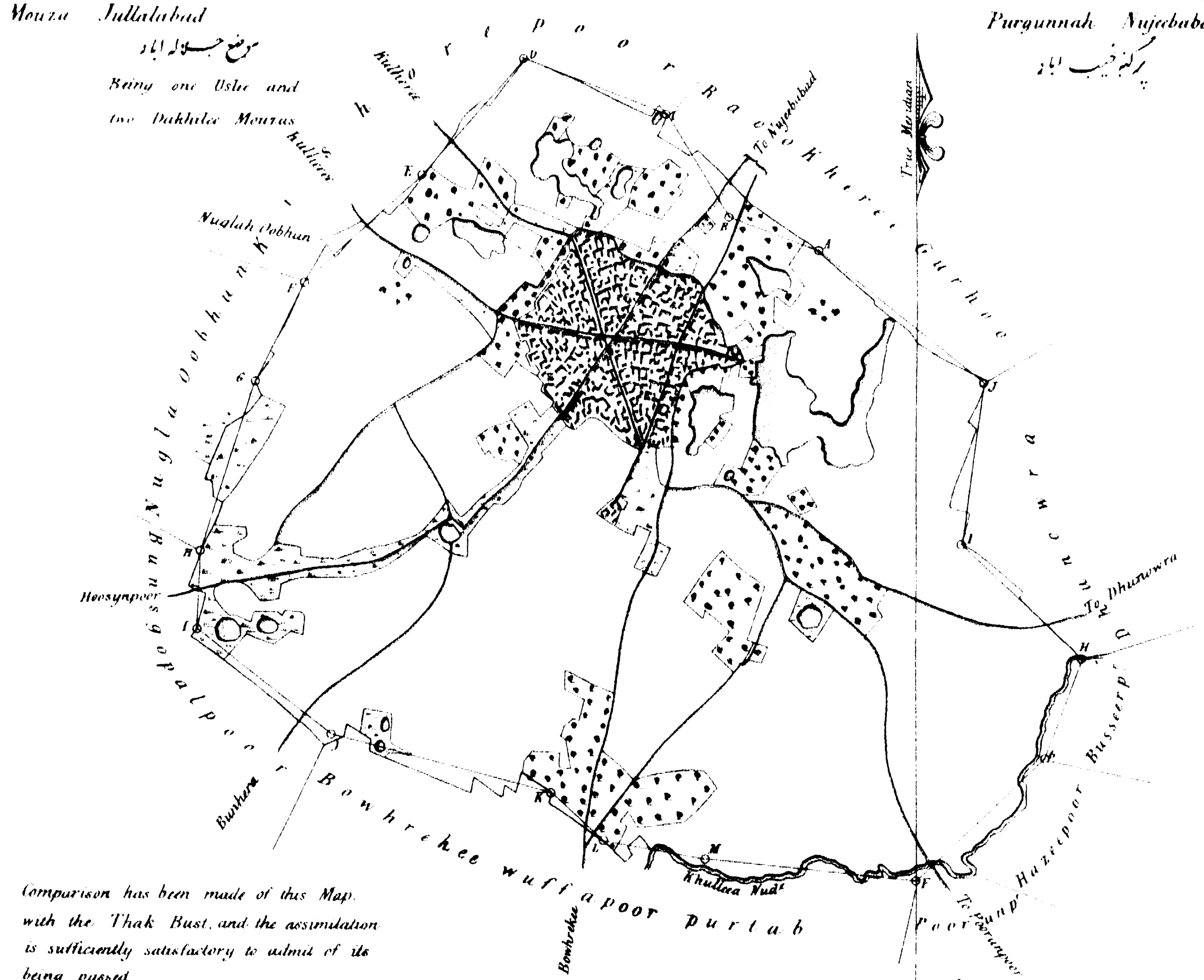
Mouza Jullalabad

موضع جلال آباد

Being one Uslee and two Dakhilee Mouzas

Purgunnah Nujeebabad

پرگنہ نجیب آباد



Comparison has been made of this Map with the Thak Bust, and the assimilation is sufficiently satisfactory to admit of its being passed

AM Lawrence
Reve Survr

Boundary Surveyed by Shaikh Golam Ally
Interior . by Shaikh Jonub Ally
Examined A. B. Sub Assistant

T. Black, Asiatic Lith. Press

H M Smith Sc

This plan and register shows work of the professional revenue survey in the Western Provinces with traverse closely following village boundary, and interior village detail [ch. xiii].

The table on reverse shows calculation of traverse from station to

AREA of Mouzah Jullalabad   Purgunnah Nujeebabad

Names of adjoining Villages	Stations	Angles		Bearings		Distances		Distances on the Meridian N		Meridian S		Perpendicular E		Perpendicular W		Distances on the Meridian of each Station from the first in the Series	Distances on the Perpendicular of each Station from the first in the Series	Sums of each Successive pair of Co-ordinates	North Products in Acres	South Products in Acres
		°	'	°	'	Chs	Lks	Chs	Lks	Chs	Lks	Chs	Lks	Chs	Lks					
	F																			
Hazeepoor	G	155	25	46	04	22	93	15	90	.	..	16	50	..		N 15.90	E 16.50	E 16.50	26.24	..
Bussterpoor	H	109	33	21	29	14	50	13	48	..	..	6	29	..	..	29.38	21.79	58.29	51.61	..
Dhunowra	I	235	52	311	02	22	40	14	70	.	..	..	..	16	90	44.08	4.89	26.68	39.21	..
	J	120	36	6	54	20	88	20	71	.	..	2	51	..	.	64.79	7.40	12.29	25.45	.
	A	160	27	307	30	27	15	16	52			.	..	21	52	81.31	W 14.14	W 6.74	..	11.13
Raoo Kheree-Gurhoo	B	220	33	287	57	12	80	3	93	..	.	..	..	12	17	85.24	26.31	40.45	..	15.89
	C	143	05	328	30	15	80	13	47	.	.	.	..	8	25	98.71	34.56	60.87	..	81.99
	D	108	02	291	35	20	00	7	34	.	..		.	18	60	106.05	53.16	87.72	..	64.38
Kishorepoor	E	186	22	219	37	20	00	.	.	15	41	.	..	12	75	90.64	65.91	119.07	183.49	..
	F	157	24	225	59	20	90			14	53	.	..	15	04	76.11	80.95	146.86	213.39	..
Nuglah Oobhun	G	173	03	205	23	14	60	..	..	13	40	..	..	5	80	62.71	86.75	167.70	224.72	..
	H	163	09	196	26	23	10	.	..	22	16	.	..	6	54	40.55	93.29	180.04	398.97	.
Bunsgopalpoor	I	126	50	179	35	10	10	.	.	10	09	0	07	..	..	30.46	93.22	186.51	188.18	.
	J	156	43	126	25	22	00	.		13	07	17	70	..	..	17.39	75.52	168.74	220.54	..
Bowhreekee wuffupoor purtah	K	207	31	103	08	29	50	..	..	6	69	28	72	.	.	10.70	46.80	122.32	81.83	..
	L	147	21	130	39	9	20	..	.	5	99	6	98	..	..	4.71	39.82	86.62	51.87	..
	M	178	06	98	00	13	15	.	.	1	83	13	02	..	..	2.88	26.80	66.62	12.19	..
Poorunpoor	F	129	58	96	06	26	96	..	.	2	88	26	80	..	..	0.00	0.00	26.80	7.71	..
Sum		2880	00	46	04			106	05	106	05	117	59	117	59					

Sums of North & South Products	1725.40	173.39
Difference	1552.01	
Half	776.00	
Area of Offsets	+ 6.29	
Statute Acres	782.29	
Beegahs of 3025 Sq.re Yards	1251.67	

D M Lawrence
Rev Survey

assistant to be given an executive charge, raised a second party for Azamgarh at the end of 1834. In 1836 Fordyce moved his party into Gorakhpur, and that district was completed by the end of 1839, with three other parties to help—Lawrence from Farruckābād—Brind with Terranneau's party from Azamgarh—and Rind raising a fourth.

James Abbott joined at Azamgarh in October 1835, and took over charge at Bareilly when Fraser resigned four months later. He had completed the eastern districts of Rohilkhand by the time he was recalled to military duty in 1838.

After completing the *parganas* of Agra and Muttra that lay on the left bank of the Jumna, Wroughton worked eastwards, completing Aligarh, Farrukhābād, Mainpuri, and Etāwāh, all in the central *doāb*, by 1839. In 1840 he moved to Mirzāpur, worked south into Sirgujah, and then took up survey in the Narbada Territories to the south. He was succeeded at Agra by Fordyce and Maxwell, the latter moving down to Ghāzipur in 1840 and then to Patna.

Early in 1833, as a first step in the new speed-up that will be described later [216–8], Lawrence was moved from Gorakhpur to Allahābād, where he raised his party to double strength, handing over to his assistants, Saunders Abbott and Stephen, on his reversion to military duty later in the year. Abbott surveyed Cawnpore, Fatehpur, and Jaunpur districts, moving to Jalaun in Bundelkhand at the end of 1840. After completing Allahābād Stephen took up the survey of Hamīrpur, Benares, and Bānda, which had been started by Terranneau in 1836. At the end of 1841 he and his party followed Maxwell's to Bihār.

All this time Birnie Brown worked steadily through north-west Rohilkhand up to the Kumaun border, whilst William Brown continued in the upper *doāb*, and in the districts to the west of the Jumna. Brown surveyed Hissār during 1837–8—Dehra Dūn 1838–9—scattered areas of the cis-Sutlej districts 1840–1—Mussoorie 1841–2—besides finishing off various *parganas* of the Delhi territory.

As the surveyors had now become responsible for the *khasrah* surveys, special detachments were formed to complete these measurements in areas of the upper *doāb*, Rohilkhand, and Delhi, that had beeen covered by the professional traverses, but not taken up by the *amīns* of the district officers. This work was entrusted to the more experienced assistants such as Nelson and William Chill [346].

With the retrenchments necessary after the Afghān war all these surveys were closed down during 1842, and the officers reverted to military duty.

The various districts, with dates of survey, and the names of the surveyors, are shewn on plate 11. Many of the *pargana* maps on scales from two inches to half an inch to a mile, and most of the general district maps, scale 4 miles to an inch, are still preserved, but only a few of the village maps and memoirs. Most of the district records, village maps and local correspondence, were destroyed during the sacking of local offices during the mutiny of 1857, but the correspondence records of the Board of Revenue at Allahābād are in good order [VII, 218][1]. The Deputy Surveyor General reported in 1860 that

> about the latter end of 1837 Major James Bedford, the Dy. Surveyor General, was directed to proceed to the Presidency and superintend the surveys in prosecution in Bengal [179].
>
> The principal records of his office were made over for custody to the Revenue Board at Allahabad, and all professional control over the operations in those provinces ceased, and the Revenue Board...alone exercised supervision over the surveys, and held charge of the original records. In June 1843 the Revenue Board...sent down to...this office 21 cases containing old records of various N.W.P. Surveys, and in July of the same year a second lot in 2 cases[2].

DEMAND FOR SPEED

The Allahābād conference of 1833 had laid down an annual target of 1,000 square miles, professional and *khasrah*, and this was attained by most of the parties.

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[1] quoted as Rev Bd. WP. [2] DSG. to Home Dept. 29-3-60, DDn. 554 (36); *pargana* & district maps [211 n.5]; many village plans in vols. bound by dists., here quoted MRIO. Rev. Svy., passed to NAI. 1955; other records with DLR. Gulzarbagh or Alipore.

The Board of Revenue assured Government that they were

> by no means desirous of pressing the surveyors beyond their powers, knowing that they are almost without one exception efficient and zealous, and that when officers are too much urged to work, correctness is apt to be sacrificed to speed. All the surveys are proceeding well[1].

Bedford, however, was more critical, and in reviewing the work of the first four years records that when he assumed charge in 1832 there were but

> four regular surveys in progress; during season 1836–37 there were nine. These quick-succeeding augmentations...brought young assistants much earlier into the charge of a survey than ...previously, ... when an officer...generally served about 5 years as assistant [214]. ...
>
> Of the nine surveys in progress during 1836–37, six were headed by full surveyors, and three by assistants in charge. Constant augmentations, ... withdrawing efficient assistants from the old surveys to aid the new ones, ... have been supplied by young men of various grades, more or less educated, but all requiring...time to qualify them for the various duties. ...
>
> The institution of native surveyors, moreover, has proved no light clog on the survey, ... [a new party being] never properly formed or in full working order before the third season.
>
> During 1836–7...the Bundelkhand establishment was almost entirely new—Lieut. Rind's in the 2nd season—and Lieut. Brind's [although in its third] was still headed by an officer just appointed to a charge, and with the loss of an efficient assistant, Mr. Paye, yet this last officer got over 458 square miles in Secunderpoor, a district so turbulent that one of the Judges at this station [Allahabad] expressed to me his surprise that its survey had been effected at all. Of the nine surveys, therefore, six only can be considered in full work.
>
> Removals of the surveys during the surveying season...throw back the work, as with Lieut. Abbott, lately from Pilibhit to Shahjahanpoor, and Capt. W. Brown from Surdhannah[2] to Hansi. So also the...delay of final orders for...new surveys until the commencement of the field season. ... This delay has occurred with almost every new survey since I took charge. ...
>
> An area of 7,455 square miles was done during the season [1836–37]...by nine surveyors, and with villages averaging 512 acres instead of the standard 828 acres.
>
> While everything was thus working well, and promising still further success, it is a matter of sincere regret that the Sudder Board, in communication with one of the young surveyors (Capt. Lawrence), and without reference to myself, should have recommended a change which by encouraging undue speed strikes at the root of professional accuracy[3].

The driving energy of Merttins Bird could not rest content. One thousand square miles a year for each party would not allow for the completion of the settlement, as he had promised, within ten years. He was not interested in any accurate topographical survey, or congregated district map fitting like a well-cut jigsaw. The Revenue Board wanted indexes to the lands held by individual holders, with a fair idea as to the taxable value of each holding; to be produced at the lowest possible cost, and in the shortest possible time.

The changes introduced on the advice of Henry Lawrence were to confine professional survey to the traverse of boundary circuits, and leave all the interior topographical survey to the Indian surveyors, whose number would be largely increased for the purpose. The Superintending Surveyor was allowed an officer assistant, and with this "double establishment", his target outturn was increased to 3,000 square miles a year. The older surveyors were invited to follow the new system, and Brown and Birnie Browne alone continued as before [222].

With his indefatigable energy and boundless enthusiasm, young Lawrence, who had none of the true surveyor's craving for precision, did not foresee the impossibility of getting trustworthy results from work of this nature [218]. Thomason, who was now Secretary to the local Government at Allahābād, as well as Bird himself, sensed the opposition felt by Bedford, who protested vigorously when he found the change introduced without reference to himself, the official survey adviser;

> It has recently been intimated to me...that an increased establishment...to accelerate progress has been sanctioned for Captain Lawrence. ...
>
> Nothing, however, can...be more injurious than these innovations on what was settled at the survey meeting in 1833 [213–4]. ... Additional work...in the civil branch of the survey has now been imposed by the recent order for furnishing complete khusruhs, whilst the...only

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[1] Rev Bd. WP. 8-9-35 (41). [2] 10 m. NW. of Meerut. [3] from DSG. 11-11-37; Rev Bd. WP. 21-11-37 (55).

> real check on the field measurements has at the same time been removed by the abolition of the interior professional survey of the cultivation. ...
>
> Yet this is the period chosen...to increase the general duties of superintendence. ... Already the local authorities are beginning to prescribe what ought to be done by Surveyors; ... a more pernicious system of interference could not prevail. If accelerated general progress be required, I...urge...new independent surveys with a responsible officer at their head, instead of imposing on surveyors—who have already quite enough to do—a mere nominal responsibility for operations which they cannot effectually check.
>
> A trial of near five years has now proved that the scheme adopted at the survey meeting has generally worked well, and the results have very closely corresponded with the estimate of annual work then made. ... Without the slightest reference to myself, the Sudder Board have selected for extra professional duties a young and comparatively speaking inexperienced officer who, whatever his zeal, ... has hitherto...exhibited evident marks of overhaste, while some of the oldest and best officers in the department...have been passed over. ...
>
> The professional survey...is...barely sufficient...to ensure the degree of accuracy required. A great fiscal survey of this nature is seldom...more than once executed in any country. It is now intimately combined with the Great Trigonometrical Survey. ... The towers of the main arc are not only employed as points to close on, ... but an annual return [is] made to the Surveyor General of all conspicuous objects [233][1].

He wrote even more strongly to the Surveyor General;

> I...submit to you as head of the Survey Department a copy of one of my letters to Government, ... that I may not be held responsible for what has been decided on without reference to myself, and is...likely to prove highly injurious to accuracy. ...
>
> Extraordinary exertions and superior talent can alone, on such extended operations as 3,000 square miles per annum from each Surveyor, ensure even that approximate accuracy which...is so essential. ... There will be a general effort after area, while the errors it may lead to cannot be discovered until it is too late to correct them. ...
>
> Under a sincere conviction that this spirit of innovation...and craving for area cannot but prove seriously detrimental to the professional results, I...place this...on record in your office where...the ultimate and only true test of our general work can be applied[2].

Bedford's transfer to the lower provinces relieved the tension, and left all the surveys of the North-Western Provinces under the direct control of the civilian secretary of the Revenue Board. His request for a transfer of his drawing establishment from Allahābād to Calcutta [345–6], to carry on the preparation of general maps, led the Board to protest against any possible resumption of his control over their western surveys;

> The Surveyors under the Board's immediate superintendence have accomplished nearly double the quantity of work which they effected in Major Bedford's time, and at a far cheaper rate, on a system which met with his most decided opposition, and there is every reason to suppose that the many obstacles which existed when Major Bedford acted under their own eye, the reluctant assent which he yielded to their views of improvement, and the tardy co-operation with which they were executed, will be increased when he is removed from their influence, and in constant communication with the officers of another Presidency who, it is believed, are by no means so urgent in completing the...survey and settlement expeditiously as the functionaries of these Provinces[3] [179].

Bedford was exceedingly hurt at this charge,

> injurious and unfounded, brought against me by the Western Board. ... To the best of my recollection, the Government orders for the extended scheme of survey did not reach me till about the middle of October 1837, and...so far from "tardy co-operation"... every arrangement in my power was made for combining the Bundelkund and Allahabad surveys, increasing Captain Lawrence's establishment, supplying him with additional instruments, and ensuring the accuracy of his commencing meridian [226]. ...
>
> That I was decidedly opposed to the 3,000 square miles per survey scheme I readily allow, and the grounds of my opposition were at the time reported both to His Lordship and the Surveyor General. Time alone will show their truth or fallacy, but...mere quantity of the work is not the sole test to which scientific operations require to be subjected[4].

Thomason saw no reason why *khasrah* survey by Indians *amīns*, checked by Indian *partal* staff, under the control of professional surveyors, should not give all the accuracy required. He was delighted with the increase of outturn;

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[1] DSG. to Thomason, Sec. to NWP. Govt. 12–10–37, DDn. 301 (204–13). [2] DDn. 301 (198–203), 2–11–37. [3] from Rev Bd. WP. 13–3–39; BRC. 10–10–39 (6). [4] from Bedford, 6–9–39; ib. (11).

> The main cause of the reduced expense and increased rapidity...is...the...plan...to dispense with the interior professional survey, and to measure the whole of the interior, waste as well as cultivated, in the native manner, i.e., by aumeens.
>
> The object...was to save the time and expense occupied in the interior professional [survey], and to [ensure] greater attention to the *khusreh* survey. The first object was fully answered, the rate per square mile being reduced from 20 Rs. in 1836-37, before the change, to Rs. 12 in 1837-38, after the change. I am not sure that the latter object has been obtained.
>
> The great difficulty has always been to impress the Surveyors with the great importance of the khusreh survey. ... That survey was perhaps never so well conducted as in Goruckpore and Azimgarh on the old system[1], ... but then it was very expensive and slow [III, 52; IV, 210]. ... Rapidity of execution is inconsistent with very great accuracy unless combined with sustained vigilance. ... It is impossible to fix the precise boundary where diminished accuracy counterbalances increased speed[2].

Thomason thought that the revenue surveyors rather overdid their striving for precision, "looking at everything through a theodolite"[3]. This represents the general point of view of civil revenue officers right up to the present day. The average Settlement Officer only requires sufficient information for a fair assessment on every holding, including a plan of its limits that shall be reasonably accurate and readily recognizable on the ground. He is only disturbed by gross errors and is not interested in a general map [211-2, 288-90]. To quote Markham once more;

> The surveys of the North-West Provinces were made at a galloping rate each season, owing to the pressure of the revenue officers, who wanted to complete the settlement. The result was that the maps were the merest, and most inaccurate, skeletons, while topographical details were altogether omitted [227]. The surveys were confined to the actual definition of village boundaries, and the work on opposite sides of a river were never even connected. ...
>
> Most of the original village plans, bound up in folio volumes, were destroyed in the mutinies, but those of twelve districts were saved and deposited in the Surveyor General's office at Calcutta [215].
>
> It would be ridiculous to attempt to use the old revenue skeleton maps of the North-West Provinces as a basis...for any useful purpose[4] [280].

DISTRICT SURVEYS: DELHI & NORTH-WEST

The revenue survey of Delhi had been started in 1822 by Thomas Oliver who had completed most of the southern districts, Gurgaon, Rohtak, and Karnāl or Pānīpat, before handing over to Simmonds in 1829. The territories of Delhi at this time also included the present districts of Delhi, Hissār (Hariāna), Ambāla, Ludhiāna, and Ferozepore, the Company's villages being much intermixed with those of the Sikh chiefs.

By season 1832-3 Simmonds had worked north from Rohtak and Pānīpat into Ambāla[5] where he found that "disputes about land have long proved a stumbling block to the...scientific survey". His surveyors were scattered over a wide area, even into Hānsi, as villages were reported ready for survey by the civil authorities. At the request of the Political Agent in the Simla Hills he took up survey round Sabāthu but was refused permission to draw his salary bills there, and ordered to confine himself to work in the plains [349]. His party was moved to Azamgarh at the end of 1833 [223].

In 1837 the Commissioner at Delhi asked that William Brown who was under orders for Hissār should take up the survey of scattered areas in the territories administered from Delhi;

> A mere geographical survey of the isolated tracts of Bulubgarh, Bahadurgarh, Hussengurh, [south of Delhi], will take very little time, and as it seems highly desirable (in order that the blank spaces in the general revenue survey map may be filled up), ... early

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[1] Thomason had been Collr. Azamgarh 1832-7. [2] from Sec. to Govt. NWP.; Rev Bd. LP., 14-10-40 (5). [3] Morris (115). [4] Markham (180-1). [5] MRIO. 1 (1, 4, 10), Ambāla; 1 (7, 9); Karnāl, 3 (6-9, 16, 18); Rohtak & Rewāri, (Simmonds 1830-3), MRIO. 8 (16), Delhi Territory with village boundaries, 1822-32.

> arrangements [may] be made by the Political Agent or Commissioner, Delhi, in communication with the native chiefs to enable Capt. Brown to take them up as convenient.
>
> Ferozepore Jageer[1] 270 square miles—Badshahpoor, 150—Hansee District, including Jumalpoor & Tohana[2], 1,620...—Captain Thoresby's[3] country of Jansee District, 1,120—Paneeput 19— Umbala, 40—Soobathu, 20—Artillery ground, Karnal, 20. ... Only about 600 square miles will require khasrah survey. This work will complete...Delhi Territory. ...
>
> Next...is the geographical survey of the independent states in the Delhi territory. The Jhyjeer country being nearest Delhi[4] would naturally come first; ... about 2,080 square miles. The Rutlamgarh and Jheend countries, 800 square miles each. ... The Kurnal and Koonjpoor Nawab's possessions, together with the Putiala and Bikaneer territories, and Bahawalpoor... are the most extensive of all, and there are a number of smaller tracts...not paying revenue[5].

Brown moved to Hissār in January 1838 with orders that

> stony and rocky tracts are to be clearly marked off to show distinctly what fertile lands exist; only such land to be rated as fertile as, on being broken up, will immediately yield a return[6].

Called away to survey the Dehra Dūn [220], Brown was back in Hissār before January 1840. "On the Governor General's verbal orders" he reported from Hānsi on the Ghaggar and Saraswāti rivers: "The Soorsootty River was come upon quite unexpectedly. ... Next year the survey...of Sirsa and Raneea in the Bhuttee States will enable the plan and report on this river to be completed"[7].

His programme for 1840–41 included a geographical survey of "Bhutteeana"[8] and its disputed borders and a report on "the slope of country and possibility of irrigating it...from the Sutlej or any other source". Lines of level to the Sutlej would "add much to the researches of Capt. Baker" [246, 390][9].

He continued survey of these frontier areas till April 1842 besides having scattered detachments nearer Delhi[10]. He writes from Jagādhri[11] that "work in progress includes scattered patches in Bhutteea States, Ambāla, Ferozepoor, Ludhiana, etc., from the Jumna to the Ghagra"[12]. His maps are mostly of a geographical nature on the half-inch scale, and projected on a square grid, sides 800 Gunter's chains or ten miles. They bear titles and notes such as—

> Villages received from Sikh Chiefs adjoining the Buttee Territory, including Ubohor, some villages received from Puteeala & Kythul—waste lands given up to Beekaneir & Bhawalpoor; boundaries in part settled by Major Thoresby—ceded villages in the District of Hissar, in the season of 1840—Map of the Bhuttee States, including the Buhawulpoor country situated between it and the Ghara of Hyphasis River[13].

Between 1832 and 1835 Nathaniel Hodges, one of the sub-assistants on the Delhi Survey, was lent to Wade, political officer at Ludhiāna, whom he accompanied on a reconnaissance down the Sutlej to Mithankot. His many surveys included one of Ferozepore and its cantonments on the one-inch scale with the country ten miles east from the Sutlej[14] [273].

MEERUT TO MUSSOORIE

Meerut Division comprised the districts of the upper *doāb*, Bulandshahr, Meerut, Muzaffarnagar, and Sahāranpur, with the Dehra Dūn. William Brown had started the survey of Sahāranpur in 1826, and in 1830 was working in Bulandshahr. His assistant George Fraser held charge in Muzaffarnagar till transferred in 1832 to relieve Bedford in Rohilkhand[15]. Areas to be served by the new *doāb* canal were left as late as possible[1] [pl. 13]. Bulandshahr and Muzaffarnagar were completed early in 1834, and during season 1834–5 the parties were principally employed in Sahāranpur where Brown again had trouble [III, 411–2].

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[1] Ferozepore Jirki, 25. m. NE. of Alwar. [2] 40 m. N. of Hissār. [3] Chas. Thoresby (1793–1862) Ben. Inf.; Supt. Bhatti States 1837–42. [4] Jhajjar, 20 m. S. of Rhotak granted to Geo. Thomas [II : 57]. [5] from DSG. 21–3–37, Rev Bd., LP. 31–3–37 (57). [6] ib. 14–7–38; MRIO. 3 (11), 5 (18, 32) 11 (31); 14 (12–30) Hissār, 1837–8. *IO Cat.* (244). [7] from Brown, 4–7–40; Rev. Bd. WP. 21–7–40 (9). [8] desert tract along fringes of Bikaner explored by White in 1809 and Boileau in 1834 [II, 63–4, 455; IV, 272]. [9] Rev Bd. WP. 6–10–40 (116–7); 13–10–40 (1–5). [10] MRIO. 7 (18–9, 22–4), S. Div. Delhi; *IO Cat.* (241); Balabgarh, 1840 MRIO. 7 (4, 17). [11] On Jumna, E. of Ambala; MRIO. 1 (11), 1840–2. [12] from Brown, 5–12–41; Rev Bd. WP. 24–12–41 (36–7). [13] MRIO. 1 (15–20); 3 (10–2, 19), 4 (1, 33–4), 83 (39–42), *IO Cat.* (241). [14] MRIO. 5 (7–8). [15] Muzaffarnagar, MRIO. 19 (47), 21 (14, 17), 22 (16–7, 48–9), 23 (14–5), 26 (9–10, 19, 26); Meerut, MRIO. 16 (13–4), 24 (45) 25 (12) Bulandshahr, 15 (19) 19 (3–12), 20 (8), 21 (16, 32), 22 (46–7), 23 (22–3), 24 (55–3); Sahāranpur, MRIO. 17 (34–45), 26 (14–5).

> The people...resist proceedings, and...would commit violence if I persisted in going on ; as it is, they seize the chain, throw down the flags, and commit other acts short of actual blows. ... The people...are stubborn Goojurs, a class that will always give trouble about boundaries if they possible can, and when a case is settled today they are ready to dispute it tomorrow. ... Zamindars of Nanoutee...attacked my party, broke the flags, and beat my measurers[2].

After completing boundaries with Aligarh[3] on the south, and with Begum Samru's lands in Meerut, Brown moved to Hissār early in 1838 [219] but was called back to the Dūn to survey lands allotted for tea plantations.

> A scientific survey of the whole area will...be necessary, i.e., of the interior of each grant and village, as well as of the mere boundary. ... You will mark off the limits and positions of the existing grants, and at the same time be prepared to express an opinion as to the most expedient distribution and allotment of the whole tract[4] [168–9].

His survey was welcomed by Frederick Young, Superintendent of the Dūn ;

> Grantees have put up their own boundary marks, but altho' put in possession, and permitted to commence operations, these boundary marks cannot be considered finally fixed till a full investigation of...objections...by zemindars—whose boundaries they may interfere with—whose cultivated grounds they may embrace—or whose pasture land, irrigation, or waterway they may intercept—has been...decided by competent authority.
>
> Hitherto I have declined...this important duty in the hope of...an experienced, responsible, Revenue Surveyor carrying it into effect. You can imagine how highly gratified I am to find that we are likely to have the aid of your experience and advice. ...
>
> It is very desirable to put an end as soon as possible to all doubts...regarding these tenures, and this cannot be effected till the boundaries have been irrevocably determined on the spot, the area surveyed, and a kuboohat registered. ... Were the boundaries of the first grants taken by Lieut. Kirke [167–8], ... Mr. Powell[5], once clearly defined...a system would be established which would render the completion...comparatively easy[6].

Brown had to point out that the Revenue Surveyor's business was

> limited to the measurement of the lands pointed out to him. ... He is strictly prohibited from investigating claims to lands, or the rights and immunities of any description. ... These matters —...before he begins—...should all be settled by the local officers, who would barely have time to perform this duty before October next, when the survey would commence[7].

Brown completed his survey "in a masterly manner" by the end of 1839, and his maps of the "Eastern" and "Western" Dūn shew all the holdings acknowledged at that time, as well as the topography from the Siwāliks to the Mussoorie-Landour range[8] [pl. 17]. The village maps of the Eastern Dūn, scale four inches to a mile, are still preserved, every page signed "Wm. Brown" between March and May 1839. They distinguish "cultivation — cultivation lately thrown out — fit for cultivation — not capable of cultivation within reason — saul and khair forests " [9]. Some villages are linked up by traverse with their small detached "*chaks*". A separate sheet named "Koodal" of only 18 acres has a note ;

> There was some difficulty in getting these lands pointed out, and being quite unoccupied and waste accounts for the difference with the khusruh measurements. The zumunder wishes to leave it altogether ; it has not been tilled for about 4 years past. No irrigation[10].

After two more seasons west of the Jumna, Brown returned in March 1842 to take up a large-scale survey of Mussoorie and Landour, where hill-sides are steep and thickly wooded, a very different proposition to the plains of the Punjab ;

> The object desired...is a correct plan of each estate or compound, exhibiting its boundary and superficial contents. To obtain such a plan, a measurement must be made along the boundaries, often leading from the lowest kud, or valley, to the highest peak, ... reduced according to the inclination of the plane. ... If it was only required to lay down the positions of dwellings, the most scientific [method] — and at the same time the most simple and short —

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[1] from Brown, 2–8–31 ; BTO. 27–12–32. [2] from Brown, 5 & 20–10–34 ; Rev Bd. WP. 14–10–34 (61) ; 28–10–34 (5). [3] MRIO. Misc. 4–6–35. [4] from Thomason, NWP. Govt., Simla, 4–5–38 ; DDn. Mgte. (44). [5] Powell family still holds property in Dūn & Sahāranpur 1950. [6] from PA. Dehra, 15–5–38. [7] from Brown, 21–5–38. [8] MRIO. 16 (20–2), 17 (54–5), 18 (19), 23 (59), 25 (55–6), 57–61, 28 (58) ; GBO. Lib. (A-27), w. Doon, lithd. Allahābād, 15–3–41 ; shows DDn. canals, Cautley & Kirke, MRIO. 185 (11–3) ; *IO Cat.* (219). [9] *Sal = shorea robusta ; cheer = pinus himalayensis.* [10] MRIO. Rev Svy.

MUZAFFARNAGAR DISTRICT
pargana Map

Reduced from part of sheet No 45 of Muzaffarnagar *pargana* maps, compiled on 2 m. scale from four-inch revenue surveys of 100 villages surveyed in Sahāranpur, 1827–8, by Wm. Brown and G. J. Fraser [III, 427, 449 ; IV, ch. xiii].

William Brown
Revenue Surveyor

Geo J Fraser Lieut^{nt}
Assistant Revenue Surveyor

> ...would be by trigonometrical operations, but the great object...is to define the extent of estates along their respective boundaries, so that the plans may be of use in case of disputes. ...
>
> The proprietors are very particular about their boundaries, and...they would prefer as much attention being paid to define them as was consistent with a moderate accuracy...in preference to a triangulation giving a few points...very correctly.
>
> The scale[1] is four times larger than the Revenue Survey plans, and I should think would answer the purpose of the smallest divisions of property. There will be a general plan of all the estates...on a scale of 40 chains to an inch, or 2 inches to a mile.
>
> The four theodolites at the disposal of the Surveyor are not capable of observing horizontal angles where the depression is greater than 17° or elevation more than 36°. ... Being in very good order, horizontal angles properly observed with them ought to be correct under inclinations of 20°. ... This survey will in effect be one of levelling by the theodolite as well as the usual course of survey. The surveyor must be instructed to level his instruments carefully.
>
> Some proprietors and tenants might be expected to object to a measuring party going over their little gardens, and disturbing the privacy of their premises by measuring around every house, and again there are others who on every occasion unreasonably fancy that natives insult them, and take the law into their own hands by striking and abusing them. The duty would frequently prove a very unpleasant one to the surveyor[2].

Brown's maps are still preserved and make an almost continuous series from Landour and Rājpur to Cloud End and Banog. They shew traverse circuits and boundaries and most of the buildings of that period[3] [164 n.2, 166 n.6].

At the close of the survey the party was broken up with the rest of the surveys of the North-Western Provinces. The amount of valuable survey carried out by Brown during the seventeen years that he had held executive charge [III, 157] was very great indeed and covered an enormous area. He and Wroughton were quite the most capable of the Revenue Surveyors of this period.

ROHILKHAND

The ancient province of Rohilkhand comprised two large districts Moradābād and Bareilly, and the independent State of Rāmpur [I : 55–6]. The modern districts Shāhjahānpur, Bijnor, Budaun, and Pīlībhīt were formed from 1814 and later. The two surveys started in 1822 under Bedford for Sahaswān [III, 154 n.5] and Birnie Browne for north Morādābād, or Bijnor, were still in progress in 1830. Browne held his charge until 1841 when his survey was closed down leaving unsurveyed a considerable area of undeveloped *tarai* and forest land along the foot-hills[4]. His work was not of the highest quality.

On Bedford's appointment to charge of the revenue surveys in 1832 he handed over to George Fraser at Bareilly. It was possibly before taking charge that Fraser made a survey of Bareilly city, cantonments, and civil lines, which shows the sites of all residences, with 23 names of occupants including that of Brig. Jacob Vanrenen. From these names the date of the survey appears to be 1830/2[5].

Fraser was relieved in 1836 by James Abbott who completed Bareilly District the following season, when he moved into Pīlībhīt and then Shāhjahānpur, which was completed before he reverted to military duty about October 1838[6].

AGRA & CENTRAL DOĀB

The districts of Agra and Muttra straddle the Jumna, and with Aligarh made up the Agra revenue division. The Revenue Commissioner of Farrukābād was responsible for that part of the *doāb* covered by the modern districts of Farrukhābād, Etah, Mainpuri, and Etāwah [287 ; pls. 3, 11].

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[1] 16 inches to a mile ; 4–inch lithd. map, Govt. Litho. Press, Calcutta ; H.M. Smith 1844 ; GBO. Lib. A(5). [2] DDn. Mgte. (36). [3] MRIO. 17 (1–11) ; 185 (11–3), Park Estate, 20 m. to inch. [4] North Morādābād, etc., MRIO. 15 (14), 16 (52), 17 (34–7), 20 (52–3, 60), 21 (3, 34), 22 (31, 43–5, 55), 24 (46–8), 25 (5–8), 26 (1) ; Bijnor, *IO Cat.* (218). [5] MRIO. 184 (38) ; Vanrenen d. 1828, but house possibly still held by family in 1832 ; 9 of the occupants named were at Bareilly in 1832. [6] Bareilly ; MRIO. 20 (1), 21 (8), 24 (24–5) ; Budaun, MRIO. 20 (47), 22 (56), 23 (2, 42), 24 (49) ; Shāhjahānpur, MRIO. 26 (17), *IO Cat.* (222).

In 1832 the Collector of Muttra was making a settlement of part of his district on the left bank of the Jumna, and was delighted to obtain the professional assistance of Robert Wroughton to supervise his Indian measurers.

> Captain Wroughton, of the 46th N.I. stationed at Muttra, and for many years employed on the revenue survey of Goruckpoor [III, 152], has...been called on to furnish information... on the subject, and...with what establishment he would in a certain time survey and map a given number of estates [231].
>
> I should be happy to facilitate such a survey, either by placing a portion of the...establishment at Captain Wroughton's disposal, or...to enable that officer to entertain native surveyors better suited to his purpose. Captain Wroughton would map and record in detail the area, cultivation, boundaries, of each estate, and the tehsildar would collect...further information...as...the basis of the settlement[1].

Official sanction was given and Wroughton undertook to make a complete topographical survey of every village with "a congregated map of the purgannah", scale two miles to an inch, shewing "the boundaries of the purgannah...and such objects of general importance as are usually afforded in geographical maps". He asked for an establishment costing Rs. 380 a month. The experimental survey which he then carried out was welcomed by the Allahābād conference [213] and brought into the official programme [214]. By March 1834 when he applied for sick leave to the hills he had surveyed 1,000 square miles and left "the maps and other documents in such trim" that his assistants could finish them off[2].

His work included 8-inch surveys of the cities and cantonments of Muttra and Aligarh and another on the 4-inch scale of the town of Surir[3]. For the *khasrah* surveys he had the assistance of James Rind during 1835. Having finished the *doāb* area of Muttra in 1835 he took up the survey of Aligarh, and the southern *parganas* of Farrukhābād, which had been commenced in 1833 by Henry Lawrence [214].

Lawrence had started survey in Farrukhābād in October 1833, having to raise a new party with the assistance only of two sub-assistants from north Morādābād, "whose misconduct and uselessness led to their dismissal" [388–9]. Yet, writes the Revenue Board, "the operations at Farrukhabad far surpassed those of Bareilly and Moradabad, and rank on a par nearly with Agra and Saharanpur, conducted by the two most zealous and able of the old surveyors" [Wroughton and Brown][4]. Lawrence and his party were called away in 1835 to Gorakhpur which had been given priority [215].

In 1837 after some hesitation, Wroughton pleased the Board of Revenue by consenting to work on "the system of extended surveys" and was given the extra assistants and establishment necessary [216]. He was then directed to survey "Sirpoorah [now Etah], Mynpoory, and Etawah"[5].

He had unusual difficulties in Etāwah during season 1838-9, the ground where the Chambal joins the Jumna being very much cut up by ravines [II, 28 ; IV, 25]. He was unable to run his traverses so as to give "a separate professional survey of...each mouzah" and the Settlement Officer was much disappointed with the results[6]. In 1840 the party was transferred to Mirzāpur [228].

Wroughton's surveys were generally of a very high standard, and the Surveyor General later refers to "your own beautifully executed surveys of Muttra and Agra" as forming "most valuable materials" for the Atlas sheets[7].

In 1838 Fordyce was moved up to survey Agra district in which Wroughton had only made a start, and he continued with Maxwell as assistant from November 1838 till July 1839 when he took sick leave. Maxwell surveyed the city and cantonment 1838–9, and completed the district by 1840[1]. The Settlement Officer particularly appreciated the work of the surveyors in "filling up the Collector's columns in the khusrah as seemed expedient and advantageous", but

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[1] to Comnr. 22-3-32; BTC. 15-5-32 (47). [2] from Wroughton, 5-3-34; BTC. 31-3-34 (28). [3] Aligarh, MRIO. 184 (26), Muttra city 27 (1), by M. Daniell, 1833. [4] Rev Bd. WP. 10-7-35 (1-2). [5] Muttra, 19 (11), 21 (19-20), 22 (27, 38, 40, 54), 23 (7, 8, 32, 34), 26 (2, 5, 7) *pargana* Maat. Aligarh, MRIO. 19 (20-1); 24 (111-6), Sirpura, 17 (52-3), Mainpuri, 22 (13), 23 (30, 33, 36, 58), 25 (13); Etāwah, 21 (13), 22 (42) 23 (45), 25 (49-51); Farrukhabad, 21 (42-3) 22 (1, 50), 23 (40, 37-8, 50), 22 25 (43), 28 (45-6); Rev Bd. WP. 3-11-37 (71-2). [6] Gubbins, I (33); Map, MRIO. 25 (49). [7] DDn. 414 (174-9), SG. to DSG. 31-7-45.

> in the area surveyed in 1838–9, the year following the drought and famine [156], from the impossibility of procuring even decent ameens for the survey work, and other causes, the survey work could not be characterized as possessing adequate accuracy[2].

A few villages in the north of Aligarh were surveyed by William Brown's party during 1839–40 [220].

Gorakhpur & Azamgarh

When Wroughton's survey of western Gorakhpur was closed down in 1830, the Revenue Commissioner, Merttins Bird, was authorized to prepare a *khasrah* survey without professional control ;

> A native Superintendent, and a Deputy Superintendent of Surveys should be employed in the Gorruckpore District, and in the Chuckleh of Azimgur. ... Parties of surveyors, ten in number, superintended by a head surveyor, ... should be employed...as qualified persons... might be found. ... If ameens be extensively employed, and European officers be placed from time to time...to verify the statements prepared, ... we think that the settlement of these districts may be completed in three or four years[3].

In 1832 James Thomason was appointed Collector of Azamgarh that had just been separated from Gorakhpur District, and the following year took up the settlement of "Chuklah Azimgurh" in the north-west part of the district.

> Pergunnah Nizamabad, ... the largest and most important in the district, was first selected for settlement soon after the passing of Regn. VII of 1822 [III, 152 n.2, 159 n.1] and was the field where every young officer first attempted to make settlements. ...
>
> All these operations were recast on the model adopted in Reg. IX 1833[4]. The professional survey was conducted by Capt. Simmonds, whilst the field measurement, where it had not been already completed, was conducted by the revenue authorities. One great evil of this was that the revenue survey, especially on its first commencement in 1833–4, was far from correct. The interior survey, especially, was often considerably in excess of the truth, as...is likely to be the case when it is not checked by the native field measurements. The culturable land was also...considerably in excess, from an opinion held by the surveyor that all land which would produce anything whatever should be classed under this head[5].

Simmonds and his party moved down from Delhi at the end of 1833 and found it impossible to work fast enough to please Thomason , who reports in March 1834

> that the operations...have been confined...to the central and south-eastern portions of pergunnah Nizamabad. Captain Simmonds is now closing round in the south-west corner, and we hope that before the termination of the season a portion only of the pergunnah, perhaps a third or fourth in the north-west corner, will remain unsurveyed.
>
> Captain Simmonds considers it of importance...that the survey should be carried on as connectedly as possible. ... The success of our...plans...depends on...being punctually supplied with our maps, native and scientific, as also computed areas, &c. ... Captain Simmonds...is now setting his...aumeens to work, and preparing the field maps in the newly selected pergunnahs.

He writes to Simmonds two months later asking that

> the survey be completed by the end of January, and that by that date we are furnished with the musahat [212 n.3] and scientific maps of the whole pergunnahs, and with the computed cultivated, uncultivated, and total areas, ... and that these papers be furnished as regularly... as completed, i.e., in equal portions at the conclusion of each week, fortnight, or month. ... They are to be the ground-work of our settlements[6].

Simmonds could not promise such outturn ; two of the *parganas* to be surveyed contained as many as 1013 villages ;

> I could not with a perfect establishment undertake to furnish more than 80 to 100 villages per month—area results and rough field plans—as the survey progresses. ... I could not anti-

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[1] Agra, MRIO. 19 (32–3) 20 (39, 44, 46); 21 (2, 5), 23 (9–11); 24 (3–7). [2] *Rev Svy*, (*India*), (150–71); *Rev Svy*, *NWP.*, (229). [3] B to CD. Jud. & Rev. 23–8–31 (7); BRC. 14–2–32 (36). [4] the result of the Allahabād conference [213]. [5] Report by Thomason, *JASB.* VIII (126) Feb. 1839; *NWP Sel.* III, 1855. XV (155 *et seq.*); paras 113–60. [6] from Thomason, 27–3–34 and 7–6–34; BTC. 4–8–34 (63).

> cipate quicker progress, ... working as the survey now does under prescribed rules and forms, not applicable in the survey of small villages. ...
>
> The work you lay out for the ensuing season cannot...be accomplished unless it be under a revision...of establishment, and the necessary instruments and books of logarithms. ... For the latter I am entirely dependent on private loans[1].

Thomason appealed for a larger survey force;

> I expect to obtain an increase of 25 per cent on the revenue of the district. About 2 lakhs per annum is the amount we may settle if the survey supply us with the work in time. A sacrifice of half of this will involve a loss of 25,000 Rs. in a single year. The question thus becomes one of simple cost. ... I hope its value as a judicial measure to the prosperity and comfort of the people will also be taken into account [182].
>
> If the proposition for an increase of establishment be entertained, it remains for consideration whether the increase be given by strengthening the...party now here, or by superadding an entirely new party, complete in itself. ...
>
> Captain Simmonds proposes to take groups of...villages of a convenient size, ... include them in one circuit, and fill in the included villages as though they were the interior of one large village. ... This sort of survey, though more expeditious and cheaper, is less accurate, and is left more to native agency. ... It is a great object to secure accuracy. ...
>
> This work I am anxious to have surveyed and settled in 3 seasons. I can engage that no delay shall be experienced in consequence of boundary disputes[2].

Bedford thought Simmonds' slow progress due

> chiefly to the very inefficient state of his native establishment. ... [He should] forthwith give his serious attention to the instruction of a proper number of smart native lads. Hitherto he has made little or no use of native surveyors on the boundary work, nor...as draftsmen or calculators. ... His European establishment has been employed on what natives have elsewhere principally performed.

He asked Simmonds, who now had Fordyce as assistant, why he could not turn out as much work as other officers, for example Brown or Lawrence[3], and Simmonds promised that for season 1834-5 the Azamgarh survey would go ahead

> at an equal rate of progress with any Surveyor similarly situated, and...bear comparison... with the Delhi survey of 1832-33. ... My letter to the Collector...was written just as the present field...work was about closing. The experience I then had was very discouraging. I had been suddenly removed when the season was already advanced. ... This...broke up the native establishment...previously entertained, and when I arrived here I found the nature... of the professional work so entirely unknown—the people on it were foreign to me and I to them—that I experienced considerable difficulty in organizing an efficient establishment.
>
> Added to this, ... Nizamabad pergunnah was totally unprepared for survey in consequence of numerous boundary disputes which cramped and shackled my exertions[4].

He showed how the small size of the Azamgarh villages involved a corresponding increase in the number of traverse circuits, and thus increase the duties

> of the Superintendent that are already so arduous in the field, exceeding more than 12 hours per diem. ... In the beginning of the present season, Mr. Gould's survey in Hansi [219; pl. 23] exceeded 40 square miles per month, and in Nizamabad with difficulty did Mr. Gould get through the survey of about 11 square miles in the month of December[5].

Output improved when a second party raised by Robert Terranneau commenced work from November 1834, and on Simmond's resignation three months later his party was taken over by Fordyce. Thomason found, however, frequent discrepancies between Terranneau's traverse control and the detail field measurement, though both were now under the professional surveyor.

> It had previously been the custom to measure the village before the boundaries were fixed. This pernicious practice had given rise to endless intrigues. ... The imperfections of the boundary work...affect the value of the survey, at least in the eastern and southern portions of the pergunnah, which were surveyed in the first season. ... In the western and northern parts, which were surveyed in the 2nd season, there is little or no fear of error. ...
>
> The survey...of pergunnah Belhabans, ... 1834-5, was conducted under the immediate superintendence of Lieut. Fordyce...in a superior manner[6]. ...

---

[1] from Simmonds, 30-6-34; BTC. 4-8-34 (63). [2] from Thomason, 2-7-34; BTC. 4-8-34 (63). [3] from DSG. 11-7-34. [4] from Simmonds, 7 & 11-9-34; BTC. 20-10-34 (49). [5] from Simmonds, 16-9-34; BTC. 20-10-34 (49). [6] Azamgarh, Fordyce, MRIO. 20 (20, 51), 22 (6, 37, 18-20), 23 (31), 24 (17), 1-inch village plans, 1835 Fordyce, MRIO. Rev. Svy.

> Pergunnah Deogaon was surveyed by Mr. Terranneau in the season of 1834–5, and settled by myself in 1835–6. The boundaries were very well laid down by the native Deputy Collector, ... This pergunnah was unfortunately chosen. ... The villages often consisted of broken fragments of land, ... some mere fields, ... scattered about at considerable distances. ...
>
> The native measurements were frequently approved and passed as agreeing with the professional when the areas were totally different. The professional survey itself is often grossly incorrect...in its representation of the cultivation, and...the boundaries. The native maps have received scarcely any check, several of them are scarcely intelligible, and, in many, fields belonging to different persons, different puttees, and even different mehals, have been grouped together in one number.
>
> The pergunnahs of Gopalpore, Kowreeah, and Atrowleeah Tilhenee were surveyed by Lieut. Fordyce in 1835–6, and settled by Mr. Montgomery[1] in 1836–7. ... The survey was well conducted. These pergunnahs are undoubtedly the best surveyed in the district.

Unfortunately Terranneau's work of 1835–6 was no better than that of his first season but, by the time this was shewn up by Thomason's settlement operations of 1837, he had been transferred to charge of the Bundelkhand survey, and it fell to Brind to make the necessary resurvey [215, 230][2].

At the end of 1835 it was decided to take up the survey of Gorakhpur—which at this time included the present district of Basti—and, to push this through with vigour, no fewer than four parties were employed[3]. Lawrence brought his party down from Farrukhābād, and Rind, who had been assistant both to Brown and Fraser, raised a new party. In 1836 Fordyce brought his party up from Azamgarh, and was followed by Brind in 1837[4].

Fordyce commenced in the *pargana* of Amorda that had been surveyed by Wroughton ten years before [III, 152], and the Revenue Board suggested that where the boundaries coincided with Wroughton's

> nothing more is needed, but if they differ a new map must be made, or the old one corrected, which ever the surveyor may prefer. A khasrah survey will be required, which the Board would prefer to have conducted by the Surveyor as usual, but if that officer should find Captain Wroughton's maps obviate the necessity for a fresh professional survey, and the heavy charge of a khusrah survey detain him from work which he could otherwise carry on elsewhere, the Collector might be directed to superintend the khasrah[5].

After some discussion it was agreed "that a new survey will cause the least trouble". It was indeed regrettable that Wroughton's painstaking work had to be scrapped, but the experience and knowledge gained had been of considerable value.

It was while he was on leave from Gorakhpur in 1837 that Lawrence met Bird and Thomason at Simla, and offered to produce at least 3,000 square miles of survey in the season, provided he was given the establishment. Early in 1838, therefore, he and his party were moved to Allahābād for him to put the new system into practice. Later in the year Fordyce's party was moved to Agra. During the rains, on the outbreak of war with Afghānistān, both Rind and Brind were called away to their military units, and their parties were broken up when the survey was brought to a close the following year, 1839[6].

In a final review of the survey and settlement, the Directors commented that

> in Secunderpore and Bhudaon[7] the operations as regards the permanently settled lands were generally restricted to the adjudication of the whole of the village area. An attempt was thus made to define the limits of each estate, and settle the...liability of each...to the Government, and at the same time to enter on the public records the...approximate value of every mehaul.
>
> The main benefit of this to the people was...the final determination of all boundary disputes, ... and...the facility afforded for the partition of property and it's transfer from hand to hand. The security to the Government for the prompt and easy realization of it's revenue was...another object of incalculable value.

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[1] Robert Montgomery (1809–87); BCS. 1827; arrd. 1828; Asst., Azamgarh, 1829; LG. Punjab, 1859–65; *DNB*. [2] Secunderpoor, Azamgarh, Brind, MRIO. 23 (35). [3] Thomason's report, Agra, 16–12–37; *JASB*. VIII; Feb. 1839 (136). [4] per order of LG. NWP. 4–7–36; Gorakhpur, 1-inch village plans, MRIO. Rev Svy.; Lawrence, 1835–7; Brind, 1838; Rind, 1838; *pargana* maps, Ourangabad, Amorha, Gorakhpur, MRIO. 19 (25, 34, 36, 40), Fordyce, 1836–8; 22 (2, 53), 23 (1), 25 (28). Gorakhpur, Brind; MRIO. 19 (48), 20 (19, 34, 35); Rind, 21 (4), 22 (23). Lawrence, 23 (21); *IO Cat.* (218). [5] Rev Bd. WP. 11–10–36 (85). [6] MRIO. 25 (29), Azamgarh & Gorakhpur: an enormous paste-up, 2-m. to inch; compiled Allāhābād 1939, very clear; with *pargana* boundary. [7] Ballia Dist.; formerly E. Azamgarh; survd. by Brind, 1836–7.

> The Government subsequently received assurances that great benefit had accrued, ... and that the opposition at first shewn...had given place to...satisfaction and gratitude[1].

ALLAHĀBĀD & CAWNPORE

Allahābād Division, which included the districts of Fatehpur, Cawnpore, and Allahābād, was the first to be taken up under the new system of "double establishment" introduced by the Board of Revenue in 1837 [216–7]. Lawrence was to bring his party across from Gorakhpur, and absorb Terranneau's party working in Bānda District south of the Jumna [227; pls. I, II, 23]. After protesting strongly against the Board's proposals, Bedford had to give way and in November 1837 directed Lawrence

> to arrive at the south-west boundary of the Allahabad District...about the 15th proximo. On your arrival there...establish a true meridian for your new operations and, in communication with Mr. Paye (who has been directed to conduct a main circuit belt along the Jumna to connect the two surveys) to compare it with what he has been working on [217]. ...
>
> As the Board appear very anxious for an early commencement...in this district, you had better not enter on the survey of any new tuppah at Gorruckpore. ... After settling the meridian with Mr. Paye near Mhow[2], that gentleman will be directed to make over his party to you [Terranneau being on leave], and you will then arrange...full employment to both[3].

With two assistants, Saunders Abbott and Stephen, Lawrence made rapid progress under the new system, and when he was recalled to military duty in September 1838, Abbott took up the survey of Cawnpore, leaving Stephen to finish off work in Allahābād[4]. He completed the professional survey by the end of December, and asked that boundaries of Fatehpur might be cleared and settled, while he completed the Cawnpore *khasrah*. By October 1839, writes the Settlement Officer,

> that zealous and indefatigable officer had completed and made over all his maps, area books, and khasrahs to my office. To prove that Lieut. Abbott did not allow the rapidity of his progress to interfere with the efficiency of his work...about one third of the original khusrahs were rejected [by him ?], and the lands remeasured.
>
> The Sudder Board of Revenue have particularly enjoined that the classification of soils should not be left to the survey establishment. ... Unfortunately these instructions were not adhered to, and...the khusrahs, when first given in, were exceedingly erroneous in regard to soils and irrigation. The officer in charge of the survey cannot be blamed for these errors. The scientific survey gives them a ready and infallible test whereby to discover and correct errors in the measurement, and that test was rigorously employed. But, with regard to... details of soil and irrigation, they must be dependent on the subordinate establishment[5] [231].

Stephen's party then took up the survey of Fatehpur and, continues the Settlement Officer,

> the first operations...were in the end of September 1838, when the Deputy Collector commenced the demarcation of boundaries. ... The only point...to which due care had not been given was the preparation of the thakbust maps [205, 233], many of which required correction. In May the demarcation...was completed, and the uninterruptedness with which the professional survey was carried on shows that the duty had not been inefficiently performed.
>
> The professional survey was commenced early in January 1839 in the western pergunnahs adjoining zillah Allahabad. ...
>
> The khasrah survey which commenced shortly after...was not carried through so uninterruptedly. Lieut. Stephen and his assistants being still engaged in the Allahabad District, he was unable to exercise that constant superintendence...without which native agency is so dangerous to depend on. Certain malpractices...were brought to light, and the remedies proved successful. The unremitting and well-directed exertions of Lieuts. Stephen and Abbott speedily effected an entire reformation. ...
>
> Lieut. Abbott is especially entitled to my thanks for the prompt and able assistance he afforded in a time of great emergency, and when Lieut. Stephen was too ill to exert himself... he immediately came over from Cawnpore, bringing with him some of his people and ameens

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[1] CD to GG in C., Rev, 4–8–42 (1, 8); BRC. 24–10–42 (23). [2] Mau, 30 m. w. of Allāhābād. [3] BRC. 10–10–39 (12). [4] MRIO. 21 (18, 23–4), 22 (9–12, 24, 35), 23 (13, 22, 54–5), 24 (8, 9. 10 10a, 59); Allahābād, Lawrence & Stephen; MRIO. 18 (18–9); 19 (29, 35); 20 (12); Saunders Abbott, Cawnpore, MRIO. 19 (38–41), 20 (2, 48, 57–8), 23 (12, 16–9, 41, 53), 24 (58–60). [5] *Rev. Setts. NWP.* II, 15–2–41.

> on whom he could depend. With this aid the work was carried on without interruption—confidence was restored—and a thorough reorganization effected. ...
>
> I found it advisable to commence the settlement in the western instead of the eastern pergunnahs, more especially as Korah having been surveyed by Lieut. Abbott, the papers of it were made over to me complete by the end of September[1].

The city and civil station of Fatehpur were surveyed by Stephen during 1839[2].

The *pargana* and general maps prepared by Abbott and Stephen under the new scheme were very poorly drawn, with none of the beautiful draughtsmanship and care that was devoted to such maps by others surveyors. Beautiful draughtsmanship was of little value for revenue settlements.

BUNDELKHAND

The regulation districts of Bundelkhand were Jhānsi, Jalaun, Hamīrpur, and Bānda. The country of the feudatory chiefs lay amongst the hills to the south [III, 81 ; IV, pl. I]. In 1836 the Board of Revenue asked for a survey of Bānda ; "nearly the whole district has been already surveyed by aumeens ; no delay will occur on account of disputed boundaries, and no khasrahs needed". Terranneau was transferred from Azamgarh to raise a party, with Paye as assistant, but after the exposure of the unfortunate errors in his Azamgarh party [224–5] he had to take long leave, and Paye carried on in Bānda until the party was absorbed by Lawrence at Allahābād.

In 1839 Stephen crossed the river from Fatehpur to take up the survey of Hamīrpur, and on completing the professional survey of about 2,100 square miles by February 1840 was ordered down to Benares [pl. II]. He returned to Bundelkhand in November to join Abbott in the survey of Bānda and Hamīrpur, and on completing the latter in November 1841, moved his party down to Bihār [184].

Abbott surveyed Jhānsi and Jalaun during 1841–2. His survey was then abolished and he reverted to military duty in October 1842[3].

BENARES & MIRZĀPUR

Benares Division at this time covered the districts of Benares, Jaunpur, and Mirzāpur. Ghāzipur was attached to Azamgarh, whilst Benares State has since become the Bhadohi District. The greater part of the Division had come under the old permanent settlement, and, this being in no way based on survey, there was much uncertainty about the limits of estates. To remedy this the Board of Revenue ordered a survey of boundaries. "There are...a number of mouzahs, the aggregate jumma of which amounts to about nine lacs of rupees, on which no permanent assessment has been fixed". They defined an Estate or *mahāl*

> as any land subject to revenue for which a separate engagement with Government has been made, or for which...a separate amount of revenue has been assessed. ... There are in the districts of Benaras many mehals containing several mouzahs, a mouza being as here received, a tract of land known by a name, lying within a known, or ascertainable, boundary, whether there be habitations upon any part of it or not [205].
>
> In all these cases the settlement has been made mehalwar, that is, for all the land contained within all the mouzahs composing the mehal, without any distribution of the jumma upon each mouza. But...the Board have considered it requisite to have the boundaries of each mouza defined, and a separate professional and khusrah survey formed of each. ... The effect of the double survey...is permanently to determine the boundaries of each mouza. ...
>
> So sensible were the people of the value of the khusreh survey to the security of their rights, that...the proprietory community came forward to request...a khusreh survey at their own expense and the survey was made [180, 231][4].

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[1] Fatehpur, Stephen 1839; 1″ village plans, MRIO. Rev. Svy.; *pargana* map, MRIO. 25 (39–41); Kora, 25 m. s. of Cawnpore, from SO. 30–9–40; *Rev. Setts. NWP.* II (307). [2] MRIO. 185 (25), 6 inches to mile. [3] Bānda; Abbott & Stephen; MRIO. 17 (56), 19 (30–34), 20 (1938, 33), 21 (9, 10, 27, 40), 22 (51), 23 (27, 44, 51), 24 (22–3); Jalaun, 5 (24), 21 (11–2, 41), 22 (41); *IO Cat.* (iii); Jhānsi, 22 (26). [4] from Rev Bd. WP. 22–6–41; BTC. 3–8–41 (19).

Abbott surveyed Jaunpur during season 1839–40, and on his falling sick Stephen was brought down from Hamīrpur to take up the survey of Benares District in 1840 [227]. Ghāzipur was surveyed by Maxwell during 1839–40[1].

During 1840 the Quartermaster-General asked that the Revenue surveyors should survey the cantonments of Chunār, Jaunpur, Benares, Sultānpur, and Ghāzipur, the scale of 8 inches to the mile[2].

At the end of 1839 Wroughton moved his party down from Etah to take up the survey of Mirzāpur, a district which stretches south into the Vindhya Hills. He asked for a copy of a geographical map, and after his first reconnaissance, pointed out that it would be impossible to follow the Commissioner's instructions to measure up separately the superficial areas of "Aghoree and Singroulee" *parganas*, as they "were little known, even to those resident adjacent, or in the Mirzapoor District northward of the river" [Son]. A chain survey would be quite impossible. He asked for

> values of stations and points and triangles of the Great Trigonometrical Survey[3]. ... It has been a reproach against the present system of revenue surveys that they have been entirely disconnected from the Grand Survey [214, 217, 233]. I have directed a trigonometrical one to be... united with a carefully conducted topographical one of the village sites, ... rivers, roads, etc. ... The khasreh measurement which I have directed to take place upon every village will elicit the production extent[4].

His survey was indeed much more of a topographical than a normal revenue survey. It was carried out by a network of triangles with sides varying from 3 to 30 miles. In the cultivated areas village boundaries and limits of cultivation were surveyed, lines of traverse being shewn on the maps. Village sites and patches of cultivation were surveyed in the hill areas[5]. Special care was taken to survey an area of Burdi, falling on the northern borders of Rewah where coal had been reported[6]. Lists of trigonometrical and traverse stations with tables of statistics are also shewn on the maps [pls. 3, 14].

During season 1841–2 there being no more work in the regulation districts of the N.W.P. [229] Wroughton took up a similar survey of Sohāgpur and Rāmgarh in Narbada Territories, between 50 and 80 miles east of Jubbulpore.

Triangulation and traverse were resolved into northings and eastings given to the fourth decimal of a mile, with co-ordinates referred to one end of the base which he measured on the Sohāgpur plain.

His Memoir[7] contains index maps showing *tāluks* and a map of the triangles, and beautiful little maps of each *tāluk*, scale 2 miles to an inch, giving topographical detail, and reference numbers against every village. It also gives tables of statistics of houses, population, revenue, acreage of different crops, wells, and animals, village by village. The quarter-inch map reduced from the survey shows *tāluk* boundaries and brush-shaded hills. It gives notes on geology and coal deposits, and on the almost fabulous Amarkantak [I : 289 ; III, 89 ; IV, 270][8].

This survey caught the fancy of Waugh as Surveyor General, as it connected with the exploration he had made during his first year in the department [270–1], and in 1844 he recommended it as a suitable pattern for a revenue survey of the Nīlgiri Hills, as it covered "a hilly and jungly tract...of considerable difficulty, but which...was satisfactorily surveyed in a comparatively short period of time"[9].

During most of the time he spent on these surveys Wroughton made his headquarters at Chunār, where he made a large scale survey of city and cantonments[10] [*sup*]. His maps are beautifully drawn, and nearly all of them have the names entered in Persian as well as English.

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[1] Jaunpur, S.A. Abbott, MRIO. 21 (1); 25 (22–3). Benares, Stephen, MRIO. 20 (11), 21 (35), 22 (14, 51), 23 (43), 24 (27–41). Ghāzipur, Brind 20 (7); **Maxwell**, 23 (56), 22 (28), 25 (36–8).
[2] Rev Bd. WP. 14–7–40 (3); DLR. 37/53 (57, 59, 87); 29–8– to 24–10–40; Sultanpur, MRIO. 185 (5, 6).
[3] Calcutta Longl. Series [III, 261–4 ; pl. 24 ; IV, pl. 23].
[4] Rev Bd. WP. 6–9–39 (440); 18–2– and 6–3–40; ib. 24–3–40 (26).
[5] Mirzāpur, Wroughton ; MRIO. 19 (1, 2, 10, 42–5, 49), 20 (1, 10, 21, 49), 21 (22, 25–6), 22 (2–6, 15, 24–6), 25 (9–11).
[6] ib. 57 (22); 84 (51); coalfield W. of Singrauli along Kachur R. from Bardi on Son ; also S. of Surguja and E. of Ratanpur to the South.
[7] DDn. 421, M 239.
[8] MRIO. 76 (57).
[9] DDn. 491 ; 4–10–44.
[10] MRIO. 20 (21).

Early in 1841 the Board of Revenue found that with the huge areas that were now being turned out, the district surveys were nearing a close, and they asked how employment could be found for the valuable trained staff.

> The entire survey of the North-Western Provinces will be completed this season. ... The establishments, after they have brought up the map work, ... will have nothing to employ themselves upon. It becomes a question whether they shall all be discharged or whether fresh work shall be carved out for them elsewhere. The former alternative the Board would be very loath to propose when the Department has been brought...to produce in each year a professional and field survey of no less than twenty thousand square miles at an average expense of only 12 rupees per mile [209]. ...
>
> They would have...a new supply of...instruments just received, ... superior both in portability and construction to any which have hitherto been used [148–9]. ... The Board... suggest the employment of the establishments in the survey of the Saugor and Narbudda Territories, or that some of the native powers may be invited to engage their services[1].

On this report, Brown's party was moved to "the Protected Sikh States" [219]—two parties, under Stephen and Maxwell, were transferred to Bihār [179, 215]—and Wroughton's party was deputed to the Narbada territories[2] [228]. A year later under, financial pressure, the Supreme Government ordered the surveys to be closed down, both in the Upper and Lower Provinces [8–9, 181].

> The costly character of the revenue surveys in the N.W. Provinces has compelled the Governor General to decide on discontinuing the survey in the Saugor and Nerbudda Provinces. ... This step His Lordship has adopted with extreme reluctance, fully acknowledging... the great advantage of having a proper topographical survey for purposes of administration. ...
>
> The President of the Council may...consider...the termination of such of the survey operations of Bengal as are not connected with actual assessment and improvement of revenue. His Lordship empowers the President in Council to proceed at once to the breaking up of such as may have unfinished costly work in hand [181][3]. ...
>
> We are anxious to be furnished with a report shewing in what respects the survey operations have contributed to the security of the revenue, the adjustment of disputed boundaries, and the general tranquility of the Province[4].

The official reports are quoted elsewhere, and the following unofficial appreciation was made by Walter Sherwill in a lecture of 1858 ;

> Collectors now know where to collect their revenue, which they not only did not know where to find, but did not find it all, and so Government, before the...revenue surveys, was defrauded, year after year, of large masses of revenue, which the minute detail of the...maps now rendered an impossibility[5] [182].

Practical Details

From 1833 to 1837, revenue surveys in the Western, or North-Western Provinces, came under the clear-cut rules introduced by the Allahābād Conference, and were closely controlled by Bedford as Deputy Surveyor General and Superintendent of Revenue Surveys [213][6].

Traverse circuits followed closely to the village boundaries so that areas could be directly computed, and the professional staff sketched in the internal topographical detail, till from 1837 this was left to the Indian measurers or *amīns*, or entirely ignored. The primary tasks of these *amīns* were the rough measurement of the fields and the preparation of the *khasrah* and *shujrah* [205 ; pl. 8].

> The native khusruh survey consists of a rough plan of the village called a shujrah, and a list of the fields called a khusruh [231–2]. The shujrah is on no fixed scale, but is so constructed as to enable a person at once to find in it any field. ... Each field...bears a number corresponding with which is an entry in the khusruh shewing the size, ... the occupant, the nature of the soil, the crop, ... and the rent [206, 231].

[1] from Bd of Rev WP. 12–2–41 ; BRC. 3–8–41 (10). [2] from Sec. NWP. 16–2–41 ; BRC. 3–8–41 (10). [3] BRC. 24–10–42 (9, 23). [4] from Govt. of I. 11–7–42. [5] Walter Sherwill, I. [6] General accounts of these Rev. Svys. will be found in Thuillier & Smyth ; Peters ; Peters' *Digest ; Rev Svys India* ; *Rev Setts. NWP. NWP. Sel.* III. 1846 (175–84).

> The size of the field is given by stating the average length and breath, and by deducing the area by multiplying the one into the other, which is the popular method of land surveying [1: 134]. ... The Settlement Officer keeps the partalling establishment of ameens[1].

Thomason discusses this *partāl* or check of the *khasrah* ;

> The difference in the cost of partalling...parties need not be very great in the case of large or small fields if a judicial plan of testing is followed. A very good plan is to run a line or two straight through a village, comparing...with the measurements in the khusreh. The remeasured line would evidently be the same whether the fields were large or small. ...
>
> The khusreh map is the important revenue document ; the professional map is only the check upon its accuracy. ... Generally speaking all contiguous patches of land belonging to the same party, and held on the same title and at the same rate, may be measured as one field, into however many small pieces it may be divided[2] [238].

Bedford was doubtful about this *partal* work. He writes when still sore about errors that had been found in Terranneau's work in Azamgarh [225, 387–8], and Nelson's in Rohtak, 1836–7 ;

> The Survey Department has never objected to any test on the Collector's part (however minute)...but it does with reason complain that as now conducted at Delhi the means employed are quite inadequate. ... The survey is either stopped until the test is completed, or else the contractors are subjected to the injustice...of having good work condemned behind their backs, as recently occurred at Rohtak[3].

In Terranneau's case the boundaries were admittedly very intricate [225], but after the completion of his boundary survey and his transfer to Bundelkhand [227], the Collector reported serious discrepancies between the professional and *khasrah* surveys which, writes Bedford,

> cannot...be disproved. I do not here allude to the erroneous boundaries which appear to have been surveyed, but the material discrepancies presented by the same line of boundary in conterminous villages. [Such work would] bring discredit on the Department, and has already...shaken the Board's confidence in the professional records.

Terranneau could not produce his original field books, and had incurred

> a very heavy responsibility by destroying records so essential...to replace the plans if accidentally destroyed, or to verify them as now required. ... You may be called upon to replace at your own expense what has been so improperly made away with.

The Board of Revenue declared Terranneau unfit for charge of a survey ;

> The usual precautions which the system affords have been neglected. The comparison of the survey maps with each other and with the khusrah maps affords the simplest means for assuring accuracy[4] [184].

In the Rohtak case Nelson was in general charge of the *khasrah* surveys, and the Revenue Board had ordered his punishment. Bedford protested that Nelson had done his duty in arranging the necessary percentage of *partal*, and had not been given any opportunity of counterchecking those areas now condemned. The Board of Revenue repeated their orders ;

> Many complaints have been made of inaccuracy in the khasrahs, and the Board have brought to the notice of Government a disposition in the Survey Department to decry and despise them as unscientific and unimportant. The Assistant...was charged with the office of supervising and enforcing the accuracy of the khasrehs. Their accuracy was challenged by the Collector. The Survey officer, relying upon the knowledge and experience of his subordinate, oppugned with warmth the Collector's objections, and much angry correspondence arose. At last the Surveyor on personal enquiry finds that his subordinate had altogether withdrawn himself, abandoned his duty, and betrayed the confidence of his superior [388][5].

Such troubles were bound to arise in a department where operations were carried on over such a vast area with a staff that was largely unskilled, and where the professional supervising staff was under pressure from above to produce a far greater outturn of work than could be adequately inspected[6].

The Collector of Muttra reports a far different state of affairs in a survey under his own personal control, started in 1831 before Wroughton's professional survey brought in an outside check. In this case there was no insistence on speed ;

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[1] *Rev Svy., India* (15–7). [2] from Sec. NWP. to Rev Bd. LP. 14–10–40 (5). [3] Rev Bd. WP 21–11–37 (55). [4] ib. 11–7–37 (25) & 22–9–37 (88). [5] ib. 8–9–37 ; (82–4). [6] cf. complaints by Collr. of Sirdanah, 16–3–40, against Brown's *khasrah amins* of party in Begum Sumru's lands [220 ; pls. 4, 11], *Rev. NWP, Setts.* I (243).

The late measurement with jureebs has been made most carefully, field by field. The tehsildar took great pains with it, and I could detect no errors. If a question were raised, ... it would be as to the practical utility of such extreme accuracy, and such an expenditure of time and money. ... In all the fields which I tested...the result was the same as that recorded, ... nor did I see any grounds for altering my opinion of the general accuracy. ... One great security for accuracy is the jealousy of the people themselves, ... who would take care that no one benefitted to the prejudice of the rest. ...

I have understood from professional men that the data on which native surveyors proceed are erroneous, and the result of their measurement generally incorrect. ... As far as my experience goes, the result generally corresponds with the estimate...of the villagers themselves.

Six month later he was able to compare the work of his *amīns* with that of Wroughton's professional survey, and gives the following results "in statute acres" for one *pargana* [402] ;

	by Collector's mutsuddies		Professional Survey	
Cultivated	50,459		50,967	
Culturable	6,764		961	
Not Culturable	5,660	62,883	11,194	63,122

The Collector has to re-distribute areas of various classes of land to correspond with the classification by the Surveyor. ... The...detailed measurement...was made by an establishment that contracted to measure the whole area, field by field. ... The expense of this measurement was defrayed by the zemindars, whilst the whole was prepared under the tehsildar and kanungoes, who checked the details and the measurements in the khasrahs. These were again checked by me. ...

I consider the professional survey to be most accurate. Capt. Wroughton certainly took the greatest pains in his survey. ... The masterly style in which he has prepared his village and pergunnah maps is deserving of praise. They will always be found most useful[1] [222].

In a later report the Collector states that

the professional survey is unquestionably a most important check on the khusreh measurement. The total areas too may be more exactly ascertained, ... but as the ultimate view of the khusreh measurement is the land liable to assessment, we may look for a greater exactitude in the latter system. At the commencement...the individuals employed under Capt. Wroughton were inexperienced...to decide with accuracy as to what land was barren, what culturable, what now waste, and what fallow[2].

The surveyor was eventually relieved of responsibility for distinguishing the various classes of land, which was obviously a duty for the civil officials [226].

The following notes were made by Brown in 1833 with a party of well trained *amīns*. The full cost of professional and *khasrah* survey came to Rs. 28 per square mile [234] with 176 days lost to field work during the year ;

4 months in the rains, June to September, 122 days — Sundays in 8 months, 32 days — Marching days in 8 months, 8 days — Holidays : —Holee, 3 days — Christmas & New Year, 2 days — Dewalee, 1 day — Rainy weather, 1 day per month, 8 days.

The following are the directions I have issued. ...

1st. While the lascars are measuring, the mootsuddee will draw in the figure of the kate[3] on the map by eye, so as to make them bound on each other as they lie, ... their direction from the village, the number of the kate. He will then enter that number in his khusrah, and the name of the mazara [occupant]. The lascars by this time will have measured the field, and he will then enter the mean length and breadth.

2nd. No time to be lost by waiting for the name of the mazara ; it will remain blank in the event of no one being there to give information. 3rd. The area of the kates will be completed in the office on the day of their respective measurements.

4th. A sub-assistant will proceed after the survey and check it by going over half-a-dozen of the fields. ... And in any kate will ask the mootsuddee it's number from his map. He will then refer to it in the khasrah, and see if it agrees in it's measurements. He will go over every tenth calculation, and compare the total area of cultivation with that of the professional survey, and report to the Surveyor. Four villages will be thus checked...in a day[4] [238].

Brown's professional and *khasrah* surveys were greatly appreciated by the Collector of Meerut, who writes ;

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[1] *Rev Setts. NWP.*; II (40-52), 12-31 to 3-11-34. [2] ib. 25-3-36. [3] *mutasaddi* = clerk, or literate measurer [III, 528]; *khet* = field. [4] BRC. 20-5-33 (4).

> 31st August 1836. Of all the records the khusrah and the field map are the most important, and form indeed the basis upon which all the rest are prepared. ... The khusrah...is the only basis upon which the rights of the inferior tenantry can be...protected. The careful...and registry of these rights is one of the most important objects of this settlement [205, 230]. ...
>
> The...professional survey forms a marked feature of this settlement. ... Instead of being guided by native mensuration, conducted...unmethodically, the Collector has before him maps prepared on scientific principles, and beyond even the suspicion of inaccuracy [178]. ...
>
> I have retained the pucks beegah, ... being the standard which is adopted in native calculations. It is easily convertible into acres, the pucks beegah being 5/8ths of an acre[1].

Brown later writes to the Superintendent of the Dūn, recommending him to fix

> on the beegha of 3,025 square yards, which is deduced from Akbar's guz decided to be 33 inches [III, 164]. Sixty of these guz being the side of a beegha, it is equal to 55 English yards. ... It is a fine large beegha, and is extensively used. No other is known in the Dehlee District. It is the beegha of Muzuffurnuggur, Meeruth, Bulundshuhur, and if you establish any other beegha you will...regret it afterwards[2].

It was indeed important to maintain the confidence of the people [206], and the Settlement Officer reports that in Sahāranpur

> an English chain had been used. ... I was pursuing the same plan in...Muzuffernagar till my mistake was pointed out, and now, having altered the chains to the size of the beega in use, I find that the people willingly attend, and the putwaree readily writes his khusreh, and often computes the area of the field before the ameen has ascertained it[3].

As described in the *Manual of Surveying for India*, the accuracy of every closed circuit was proved by two rules of geometry regarding the interior angles of a rectilinear figure, and the equating of northings to southings, and eastings to westings. Areas were calculated from what was known as "Gale's Universal Theorem", to the effect that the difference between " north products " and " south products " was double the enclosed area [III, 148 n.1][4]. Circuits were run closely along boundaries, and rectangular co-ordinates and "products" were computed from traverse tables [pl. 12]. Waugh records that

> the system pursued by Indian Revenue surveyors is called Gale's method, having been originally invented by a land surveyor of that name in the prosecution of his professional duties as a measurer of private estates [III, 449]. It is based on two elegant self-evident properties inherent in all plane polygons, the sides and angles of which are measured, and the former reduced to lines of direct and perpendicular co-ordinates[5]. ...
>
> No system could be devised capable of being so easily taught or of being practised with greater despatch, but it was never intended by its author to be employed in the measurement of large areas such as countries and provinces. ...
>
> This system of mensuration becomes liable to great accumulation of errors, a result that always attends the principle of proceeding from small to large quantities. ... Moreover, as the errors do not combine by any known law, ... it follows...that the total discrepancies...on... contiguous circuits will not be similar or proportionate to each other, whereby the combination of many such circuits will obviously be inharmonious and discordant[6].

The traverse tables used were generally the ordinary Navigation Tables. More convenient tables had later been compiled by Garrard of the Madras Engineers [II, 217], and later by John Egerton [183], but those that won most favour were published by John Boileau in 1839 [239].

It was on Bedford's initiative some time before 1837 that the system of special main circuits was introduced [209]. Such circuits, connected with the Great Trigonometrical Survey where possible, enclosed areas from one to two hundred square miles each, and were then broken down by cross circuits and lesser lines following village boundaries. The earlier system had been to compile the general maps from a congregation of village circuits, building from the less to the greater.

In their standard work on the revenue surveys of Bengal, the *Manual of Surveying for India* that was issued in 1851, Thuillier & Smyth note that

> as a general rule the term "measurement" is always applied to the khusreh proceedings, while

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[1] *Rev Setts. NWP.* I (163, 180), *et seq.* [2] from Brown, 25–6–38 ; DDn. Mgte. (44). [3] *Rev Setts. NWP.* I (64), 1–2–39. [4] Thuillier & Smyth (272–4, 291). [5] Gale' *Traverse Tables* form appx. to vol. II of *Geographical & Graphical Exercises* by Geo. Adams. 1790 ; Wroughton also quotes "an American work, *Theory & Practice of Surveying* by Robt. Gibson ; *NWP Sel,* III (179). [6] from SG. 29–1–44 ; DDn. 452 (79–94).

> that of "survey" more properly belongs to the scientific portion of the operations. ...
>
> Demarcation of boundaries and settlement of disputes is carried on by a distinct establishment. A covenanted civil officer with the powers of a full Collector, having...uncovenanted Deputy Collectors, peshkars, and ameens, ... precedes the survey in such a way that the Surveyor may always find adjusted boundaries...to keep his parties in full work [238]. ...
>
> He has to furnish a sketch map of the boundary of every village demarcated, exhibiting the points at which mud pillars (or thaks) or other marks have been erected at certain measured distances. ... The village *thakbast* is...required for constant reference, and is placed in the hands of the European assistant who undertakes the professional survey [205 ; pl. 8][1].

Attempts had been made from time to time to use surveyors for enumeration of village populations. This always led to trouble, as in the case of Mackenzie's surveyors in the south [II, 213, 367 ; III, 418]. Such unwelcome duties had been assigned to the Bengal revenue surveyors in 1822 [III, 152, 154, 156], but withdrawn by the regulations of 1833. In 1836 the Revenue Board once again introduced them, attaching special "statistical mootsuddies" to each survey party to enumerate " the population, ... specifying merely the sex, and whether Muhomedan or Hindoos, and whether belonging to the cultivating classes". The following month they withdrew mention of " sex "[2].

The first regular decennial census in India was that of 1881, and in 1858 Walter Sherwill tells of a "sharp reproof" passed by the Court of Directors to

> the revenue surveyors in general for...representing the density of population in India as far greater than in the most densely populated country in Europe, Belgium. I remember well the amazement with which we surveyors read this despatch, ... but the next district surveyed gave the same astonishing numbers, ranging even in one district up to 508 souls to the square mile, the figure for Belgium being 296[3].

To facilitate the connection of the revenue surveys to the Great Trigonometrical Survey for mapping purposes, Everest asked Bedford to keep him advised of

> any eminent points, ... because, by intersecting them from two or more of my principal stations, I shall be able to connect your work. ... As the two works will have been carried on under different systems, it does not follow that the relative distances between places given by the Revenue Surveys will correspond precisely with the...Great Trigonometrical Survey[4].

Even as early as November 1834, when he was laying out his base in the Dūn, he asked Wroughton for a plan of all prominent points fixed by his Muttra Survey, so that he could "furnish you with their correct latitudes and longitudes, as well as their azimuths, as observed from my principal stations" [217, 222][5]. Most of Wroughton's maps have lists of trijunction points with rectangular coordinates, and of trigonometrical data falling in the area [228]. In 1838, Fordyce obtained points from the Great Arc for control of his Agra survey ;

> Much time of a valuable European sub-assistant is lost by the present practice of making grand circuits. I propose dropping the same, and substituting...the points established by the Trigonometrical Survey...over the whole of this district. This will check my distortion of work more effectually than the old way[6].

We may conclude this account of "practical details" by reference to order No. 55 of 1835, by the Sadr Revenue Board at Allahābād, which forbids correspondence in Persian between Revenue Collectors and Survey Officers, "owing to errors and misunderstandings that have arisen from this medium, whether from the inadequacy of the language, or ignorance of the officers employing its terms". The English language was to be the sole medium of communication[7].

OUTTURNS & COST-RATES

The survey carried on between 1822 and 1832 had proved slow and expensive because of the high standard of accuracy demanded, and the time spent on survey of topographical detail, collection of statistics detail, and mapping. The salary of the surveyor in charge amounted to half the total expense. From 1833 output was increased by cutting out unnecessary work—increased employment of cheap Indian staff—and transfer of the *khasrah* survey to the control of the Surveyor, whose salary now became only one-fifth of the whole [213, 346].

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[1] Thuillier & Smyth (576-6). [2] NWP. Rev. Bd. 6-5-36 (25) ; 21-6-36 (21) ; 19-7-36 (36). [3] Walter Sherwill (19) ; the mean density of population to the sq. m. for the whole of lower Bengal rose from 521 in 1901 to 742 in 1941 ; *Census of India*, 1941, IV (12). [4] June 1833, DDn. 301 (34-6). [5] DDn. 321 (285-6), 1-11-34 ; *v.* MBIO. 23 (37-8), Farrukhābād. [6] DDn. 347 (266), 7-11-38. [7] DDn. 623 (8), 28-8-35.

Brown had for several years effected considerable reduction of his cost-rate by the greater use of trained Indian surveyors [211], and in 1832 he made an experimental survey, from which he deduced a cost-rate of Rs. 28-8-0 per square mile for full professional and *khasrah* survey [231].

> Nor can there be the smallest doubt...that with an addition to...lascars...the area would amount to much more than my own estimate of 1,000 square miles, and the cost probably be reduced under 20 rupees the square mile. ... All that remains is to render the other surveys equally efficient and economical. My estimate included European labor for the boundaries. It would be a material saving, however, if these could also be generally entrusted...to natives. ... The proof of the whole work by traverse rests with the Surveyor and his assistants[1].

The first table below shows outturns and cost-rates per square mile for the more experienced surveyors, working full seasons, covering both professional and *khasrah* survey. The second table gives similar figures for all parties.

Districts		Surveyor	Season	Sq. Miles	Rupees	Cost-rate
Upper Doab	..	Brown, Wm.	1836-7	2435	28, 306	11-09-01
,,	..	,,	1837-8	2853	31, 772	11-02-02
Rohilkhand	..	Abbott, J.	1836-7	1536	24, 685	16-01-01
		,,	1837-8	2835	27, 430	9-10-00
		Browne, B.	1836-7	968	25, 768	26-09-11
		,,	1837-8	1576	28, 225	17-04-04
		,,	1838-9	1456	31, 945	20-07-05
Gorakhpur	..	Fordyce	1836-7	868	25, 183	29-00-02
,,	..	,,	1837-8	1871	28, 463	15-03-03
Agra	..	,,	1838-9	2893	40, 936	14-02-04
Gorakhpur & Allahabad		Lawrence	1836-7	1791	24, 833	13-13-10
		,,	1837-8	3641	42, 249	9-13-04
Cawnpore	..	Abbott, S.A.	1838-9	5090	56, 737	11-02-04
Agra & Aligarh	..	Wroughton	1836-7	1471	8, 318	19-04-00
		,,	1837-8	3854	41, 394	10-11-07
Mainpuri	..	,,	1838-9	4262	49, 525	11-09-01

			Profl.	*Khasrah*		
All surveys	1835-6	Area	5391	2657	1, 89, 312	27-05-11
	1836-7		7455	3175	2, 21, 559	20-13-05
	1837-8		28, 422		2, 57, 385	12-01-09
	1838-9		19, 461		2, 60, 974	13-06-06

These tables clearly indicates the sharp increases of outturn and expenditure from 1837, with corresponding fall in cost-rates [218]. As already noted, Bedford was strongly opposed to the loss of accuracy entailed and, after his transfer to Calcutta, he refused to hustle the surveyors of the Lower Provinces where "he has never since the first year of assuming charge indulged in a hope of reducing the average cost below Rs. 35 or 40 per square mile [209]"[2].

[1] from Bedford, 20-10-32 ; BTC. 4-12-32 (197).

[2] BTC. 8-9-40 (71).

CHAPTER XIV

BOMBAY SURVEYS

Revenue Surveys, Deccan & Gujarāt — TOPOGRAPHICAL SURVEYS; *Deccan & Konkan — Gujarāt & Kāthiāwār — Sind & Baluchistān — Coastal Maps.*

THE revenue surveys by Dickinson and Tate of the thickly populated city and suburban lands of Bombay and Salsette had been carried out with scientific accuracy and the greatest detail, and remained of practical value up to the early years of the 20th century [III, 167–9]. The Gujarāt surveys under Williams and Cruikshank, had also been carried out with minute accuracy and showed individual fields, but failed to meet the workaday needs of the district revenue officers, who preferred to base their assessments on the old familiar methods of the country which, in spite of their lack of precision, commanded the respect of the tenants and cultivators [III, 169–71, 173–4 ; IV, 9, 206, 210, 239].

In the Deccan the British revenue authorities had long been striving to work out a better system of assessment than that inherited from the Marāthas. The successive Collectors in the southern districts, Grant Duff, Chaplin, and Thackeray, had started surveys on the model of Munro's survey of the Ceded Districts of Madras [II, 180–2], using Indian measurers under well-organized Indian control [III, 171]. In 1826 Robert Pringle had been placed on special duty as Superintendent of Survey and Assessment. Working in the Poona and Ahmadnagar districts, he continued till July 1831, when his results were brought under close review[1] [III, 172]. He was himself convinced of the value of his work ;

> A measure...for...the reform of abuse and adjustment of inequality...had not been unattended with dissatisfaction to those whose interests have suffered by it's operation. But... it is already hailed with hope, and...will come to be...relied upon with confidence, ... and... compared to those institutions of the ancient Mahomedan governments, the fame of which has perpetuated their name in this country [I : 133–4]. ...
>
> I have had thirteen hundred and fifty carkoons[2] employed under me, in a country extending over more than twelve thousand square miles, upon very small salaries. ... My tents have been at all times open to all who had any complaint to bring against them, and I have travelled through every part of the districts I have settled and, unattended by any of my establishment, have assembled the ryuts of each village separately, and questioned them as to the conduct of my agents. ... In a period of five years I have received only twenty-eight specific complaints of oppression, malversation, or corruption. Almost all of these related to very venial offences ; nineteen proved on enquiry to be without any foundation ; in two there was strong suspicion but no proof ; and seven only were substantiated[3].

The Principal Collector of Poona was strongly critical[4], and was supported by the Revenue Commissioner, who commented on

> the inadequacy of the agency appointed. ... The vast number of natives engaged... — their ignorance of the duty when first employed—and the absence of that security for their fidelity which permanent service affords—conspired to render supervision unnaturally necessary. ... The supervision which was actually exercised was anything but efficient. ...
>
> The most important branch of Revenue Survey is undoubtedly the field work. Of such importance was it considered in the Revenue Survey of Guzerat (which experience has proved so correct), that for several years after its commencement it was conducted by scientific European officers in person and, though the measurements were afterwards made by natives skilfully instructed by them, they closely...checked their work. ...

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[1] Bo. Castle, 14-4-31 ; BTO. 27–12–32 (98). [2] clerks [III, 393 n.5]. [3] from Pringle, 21–9–31 ; BTO. 27–12–32 (102). [4] ib. (109).

> The Guzerat survey was confined to mensuration, and the collection of statistical information throwing lights on the capacity of the land, the condition of the people, their resources, &c. It did not itself act on the data it recorded ; hence the natives employed in it were exempted from that temptation which arose from the executive character of the Deccan Survey. ...
>
> The means taken to secure accuracy were inadequate. ... The English Superintendent, by...personally verifying...when and where least expected, ... would have established a check ...from which there would have been a difficulty of escape, but...the examination appears to have been almost entirely confined...to occasions when occupants of land were dissatisfied. ... This rule was necessary to the protection of the Ryot's interests, but there was no corresponding provision to guard the rights of Government. ...
>
> The Principal Collector has described...some scrutinies he made into the details of the measurements and assessments, in both of which...he has detected great inaccuracies. ... Details are given of a field which measured 115 acres being recorded by the survey at 41, and which would have been justly assessed at 164 rupees being actually assessed at 34[1].

In October 1834 Shortrede was called from his trigonometrical survey [9, 73], and deputed to make a professional check of Pringle's work[2], by which to show

> whether the survey is to be entirely abandoned, or whether it is to be made the basis of future settlements. ... The guilt of several parties concerned in the execution of the late survey has indeed been fully established, ... but it would still be satisfactory to have it ascertained how far the misconduct of these men has affected the accuracy of the work in each village[3].

Shortrede's report was passed to the Government of India who agreed that Pringle's survey had been unsatisfactory, and should be revised. Pointing out that the Bengal surveys would have given less anxiety if they had been pushed through rapidly with larger establishments, they asked the Bombay Government for an estimate for each district, giving " the extent of the district, and within what time, and at what expense, ... the new measure will be completed[4]. Sanction for a new survey was passed to the Revenue Commissioner early in 1837 ;

> The officers to be employed...are not to be tied down to an unbending mode of procedure. They will restore and revise the mamool assessment wherever that system may be found tolerably complete, and will correct the survey rates where their errors are discoverable, but when the...rates will not admit of correction, the officers will have to introduce a new assessment and to make new measurements. ... They will consult the feelings and prejudices of the people, and, avoiding all violent change, revert when practicable to ancient usage, and introduce a system of simplicity and moderation[5].

The Revenue Commissioner reported that

> the Poona Principal Collectorate comprises twelve large talookas. ... One of the...assistants has charge of three, two of two, districts, and three, including Lieut. Shortrede, of one each. ... The charges vary in extent from between 4 and 500 to upwards of 1,200 square miles. ...
>
> The additional assistance...to aid...the revision of the assessment consists of six military officers, selected for their acquirement in the native languages, and their general fitness, ... with a small native establishment to be attached to them personally, besides...additional native agency to the amount of rupees 280 per mensem, at the disposal of each Assistant[6].

The surveys were started during 1837 under a civil superintendent, Henry Goldsmid[7], and amongst the military officers first employed were Wingate, Nash, Bellasis, Davidson, Wells, Gaisford, and Robertson [366, 369]. Work was commenced in the Sholāpur District, checking and correcting Pringle's survey, and often having to make a new survey altogether. In 1840 a report[8] was prepared at Poona under the joint signature of Goldsmid and Wingate, Superintendents of Survey and Assessment in the Deccan, discussing

> the expediency of adopting the methods...followed in the North Western Provinces. ... In the N.W.P. assessment is made on estates which may comprise a single village, or part of a village, or an aggregation of villages or parts of villages. Instead of being the property of one individual, the estate is almost invariably that of many proprietors who are jointly responsible for the payment of the tax. ... In the Deccan, on the contrary, the divisions are fields of moderate extent, conveniently cultivatable by one person, and the tax fixed for each field.

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[1] BO RC. 51/595/1834 (1-9) ; 27-4-34. [2] in place of Dowell whose health had broken down [III, 439, IV, 366]. [3] ib. (245, 267-74), 30-8 & 21-10-34. [4] BO RC. 8-1837 (21-6) ; 23-1-37. [5] ib. (102-13), 23-2-37. [6] from Rev. Comnr. 13-4-37 ; ib. (61-5). [7] Henry Edward Goldsmid (1812-55) BO CS. ; *DNB.* ; in ch. Nāsik Subdn. till 1841 ; *v.* Biog. Notes [445]. [8] dated 17-10-40 ; Poona Rev Svy. (Appx. I) ; *Rev Svy.* (*India*) (362-75).

> In the Deccan no estates have been...disturbed. In 1840 each village had its known boundaries, determined and recorded. We have accurate records of the extent, capability, and position of each field, ... and though we have no scientific delineation of the boundaries of villages we have maps shewing the relative positions of fields and topographical details, carefully prepared under European supervision, much superior to the khusrah maps of the North Western Provinces.
>
> In the N.W.P. the proprietors are entitled to extend cultivation over all waste land within the estate...without further assessment, but in Madras and the Deccan no extension of cultivation may be made without further assessment.
>
> In Madras...the survey was not checked by a professional measurement, ... while the absence of maps is considered an insuperable objection to any survey professing to specify the contents of each field. The latter objection does not apply to the present survey of the Deccan, which is illustrated by village maps superior to the khusrahs of the North Western Provinces, and the work of the native measurers is also checked by a professional measurement by European Officers ; not, however, by surveying the whole area of a village, but more effectively ...by selecting and resurveying a portion of the work of each measurer in every village.
>
> The work of our native measurers is performed by means of a cross staff and chain, as... has been adopted in the latest surveys in England, where great accuracy in ascertaining the areas of small spaces is an object. The maps have also been laid down of late by our native measurers according to a scale, and admit of being constructed with an extraordinary degree of accuracy, considering that this is done without the aid of instruments for measuring angles.
>
> We cannot tell what degree of accuracy has been attained in the khusrah...by amins in the North Western Provinces. It does not appear that the checks...include a systematic remeasurement of a portion of the amin's work, without which the method would be unequal to the detection of any but gross mismeasurements [220 30]. In the Deccan...every field is subjected to a careful examination during the progress of classification to prevent gross errors ...remaining undiscovered, but we place no confidence in this as a means of ensuring accuracy, ... for which we rely wholly on the test of remeasurement made by the European officer.
>
> The ascertainment of the area of the whole village forms no safeguard against fraud on the part of an unscrupulous measurer, who would always take care that the total results of his measurements were not affected by particular deviations of accuracy he might make in recording the area of individual fields.
>
> The professional survey of the village boundaries is a feature of the N.W.P. system to which we have nothing similar here. ... The demarcation of village boundaries and the settlement of all existing disputes are also effected...in the North Western Provinces. We...have been hitherto unable to give them effect here. ... At present all village boundaries, regarding which no dispute exists, are described, and their positions indicated in the village maps. All disputed portions are also measured and mapped as such, leaving the title of the contending parties for future adjudication[1].

The Governor General expressed surprise that the survey produced nothing of topographical or geographical value, but the Bombay Government remained quite satisfied that their surveys should be confined to the purposes of land revenue.

> The boundary of two contiguous villages would in no case exactly correspond, and therefore the maps of every village, ... if placed in their relative positions, would convey no correct impression of the shape and size of the whole division. It would be well if we could...provide for such accuracy as that which the Supreme Government seems to desire, but such is not, nor was it ever intended to be, the object of our present operations. ...
>
> For revenue purposes the present rough maps are perfectly sufficient and, if a field register is at the same time well drawn up, ... no further record can be required[2].

In describing the detailed procedure of the survey Wingate explained that it had been instituted for revising Pringle's operations ;

> Complete remeasurements of villages have rarely been necessary. ... The present survey... was instituted for purely revenue purposes only, and the question of rendering it subservient to those of geography and topography is now mooted for the first time.
>
> In surveying any village, ... the first step taken is to send an order to the village...that on a certain day a carkoon will arrive...for its measurement, and directing them to inform every owner of a field...to have in readiness stones...to be sunk as landmarks...at each corner or bend of his field. ...

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[1] *Rev Sry. (India)* (362–75) ; *Poona Rev Sry.* (Appx. I. p. 9). [2] from Sec. to Bo Govt. to Rev. Comnr. ; BO RC. 109/1841 (219–21), 29–3–41.

The patel and accountant are also required to...accompany the measurer daily into the field...to point out the proper boundaries...and fix the boundary marks [187].

A measurer...is provided with a field-book, every page...numbered and signed by the European officer. ... No erasures...are permitted, any erroneous entry being indicated by a line drawn through it so as to leave the original writing easily legible. ... The record...of each day is...prefaced by a list of the village officers who accompany the carkoon to the field. ...

The measurer then chains the boundary of the field, laying down the land-marks, and making a sketch of its shape in his field-book as he goes round, on which he notes down the number of chains each side is long. The length of the several sides of the field are roughly laid off in his field-book from a scale of equal parts, by which he is enabled to make his sketch very nearly in accordance with the actual shape. ...

The area...is obtained by dividing it into triangles, and measuring the length of the bases and perpendiculars, the position of the latter being obtained by means of a cross staff [I : 134]. ... Should there be a well in the field, or a road or water-course cross it, these are also shewn upon the sketch. ...

The village map...is prepared...by the measurer after his return from the field, each field being plotted separately, and then transferred by means of tracing-paper to...the general map. A good deal of adjustment will be required to make all the fields fit. ... To assist this, ... the position of each village and that of two or three of the principal roads or nullahs...are sketched in the European method by means of a surveying compass or theodolite, ... and, the whole village lands being thus divided into sections of moderate size, the limited number of fields comprised in each are easily adjusted [III, 147–8 ; IV, 200]. ...

Though maps of this kind would prove if little service for geographical purposes, yet they exhibit the topographical features of each village with considerable accuracy and great minuteness. ... With the addition of a scientific circuit of village boundaries these maps might be rendered sufficiently accurate for every purpose, but this...is hardly of sufficient importance to repay the large expense [231]. ...

There are five distinct operations.

(1) Every portion of land...within the village limits is measured...in detail by...cross staff and chain. The particulars...are detailed in a field-book...and...upon the village map, which is constructed from actual measurement.

(2) The accuracy of this measurement and map is ascertained by systematic test...by the European officer.

(3) Every portion...is again submitted to examination by the classifiers, by whom also the nature...of its soil...[is] recorded.

(4) The...classification is systematically tested by the European officer.

(5) The site of the village and...the principal roads and watercourses...are fixed by the European method of detailed survey. ...

A system...more accurate and complete than...operations in the North Western Provinces[1].

The Bombay system differed from that of Bengal in other practical details.

The *minimum* area to be measured separately...and constituted a "number"...was fixed... at what two bullocks could plough. ... The *maximum* area...must not exceed the means of the generality of the ryots to cultivate. ... Cultivators possessing two pairs of bullocks were found ...to form the most numerous class, ... and the *maximum* area was consequently fixed at what four bullocks could plough. One pair of bullocks are able to plough 20 acres of light dry crop soil—15 of medium—12 of heavy—four of rice land [230]. ...

A system of detached earthen mounds, two at each of the four corners of the "number", and one at convenient intervals, was found on trial to be a sufficient demarcation [233]. ...

The European assistant has usually some twenty measurers and three learners...under him. His duties are to supervise and test the work of these men, ... making no original surveys himself. ... Villages are rarely of such a size that they cannot be done single-handed by one good measurer in a season. ...

The chain with which the areas...are ascertained is 33 feet in length [III, 164], ... and is divided into 16 links called annas, of 2 feet ¾-inch each. Forty of these square chains make an acre, and is called a *goonta* [III, 164].

The Measurer is provided with a wooden staff...8 feet 3 inches in length for...constantly testing his chain. He is supplied also with a pair of compasses and a diagonal scale shewing chains and annas. His map is constructed to a scale of 8 or 16 inches to the mile. ...

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[1] from Wingate, 30-12-40; *Rev Svy.* (*India*) (375).

> All the work that has been done in the fair season has to be revised in the rains ; the corrected results are tabulated, ... and two fair copies made of the village maps for the Classing Department. ... It becomes nearly impossible to pursue field operations after the first fall of rain in June, and all the establishment return to headquarters by the 15th of that month.
>
> The multiplication of the lengths and breadths of the internal figures, triangles and trapezoids, in which each survey number has been broken up by the chaining operations of the measurers...used formerly to be done by actual computation, but the product is now obtained from multiplication tables made up as far as 40 chains by 40 chains, and lithographed. ... Their introduction has effected as much good on the Bombay side as Boileau's Traverse Tables did in Bengal and the North Western Provinces [232].
>
> The entire area of each number is tested by means of the talc square on the map, so that it is next to impossible that any serious error in area can remain undetected.
>
> All these processes gone through in the rains are tested to the extent of 10 per cent by the Assistant himself[1].

In a report of 1841 the Revenue Commissioner reported that Wingate's revision of Pringle's work in Poona and Sholāpur had been completed ;

> In...the survey under Mr. Goldsmid's charge, all the measurements are made *de novo*, for though parts of the Nassik districts were surveyed by Mr. Pringle, his survey was never acted on, and its correction would...have entailed more trouble than an entirely new survey. Both in the northern and southern Deccan the classification is entirely new, that of Mr. Pringle... having been found too faulty to admit of correction. ...
>
> The village maps made out by the Deccan Revenue Surveys should be of considerable value for topographical purposes, and with one of Major Jopp's maps as a general index [306–7] I am at a loss to know what further can be required[2].

Half-hearted enquiries were made at this time, both from Shortrede and Jacob, as to the nature of assistance that could be given either by Jopp's ¼-inch maps of the Deccan survey [III, 125–6 ; IV, 240], or from the Great Trigonometrical Survey [73–5]. In neither case was there any material that could assist the Revenue Surveyors without extensive professional labour, and indeed most of the topographical records had been scattered beyond recovery[3].

Wingate mastered the problems of land revenue to such an extent that it was not long before he was entrusted with the control of assessments as well as of survey, an arrangement the Directors did not like [367] ;

> Our Civil Servants on the regular Revenue establishment have been excluded from share in the operations for which they are best qualified. ...
>
> The measurement of the lands may certainly be best undertaken by...scientific officers trained by previous habits and experience, ... and the classification of the soils may...be... safely entrusted to their hands. But the vital...imposition of the proper assessment...should... devolve mainly on the Collector and his assistants, with...any information which the surveying officer may have been enabled to collect. ... The services of the surveying officers should be restricted to the measurement and classification of the lands[4].

They withdrew their objection when the Commissioner explained that Wingate and Nash had originally been sent in 1836

> as Survey officers under the general superintendence of Mr. Goldsmid, by whom the settlements were to be made. When the latter officer quitted the superintendence...in that part, ... Lieut. Wingate was selected to succeed him. ... He has been most successful.
>
> The survey under Lieut. Wingate is the only one in which the two duties of Survey and Assessment are combined. ... In the Nasik survey the survey is conducted by officers under Mr. Goldsmid whose duties are those of Superintendent and Settlement Officer, and...for... the Southern Mahratta Country he proposes that the two branches should be kept perfectly distinct. ...
>
> The survey department should be subject to...the officer entrusted with the settlements. ... In the Broach and Guzerat survey we have an example of the evils of a contrary mode of proceeding. Though the scientific part of the work was most ably executed, and the... information collected most minute and extensive, it is to this day comparatively useless. ... having been conducted without any reference to...the local revenue officers, so that the wants of the latter...were frequently lost sight of [III, 173–4 ; IV, 235].

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[1] *Roorkee Papers* CX. III (186–93) cf. *Bo Rev. Svy.* [2] *Rev. Svy.* (*India*) (378), 15–2–41 (19–20).
[3] DDn. 325 (58), Shortrede to Bo. Govt. 16–9–41 ; 519 (65). Rev. Survr. Dhārwār, to Jacob, 21–1–42.
[4] BO BC. 1415/1842 ; 82 (1–2), 1–9–41 ; CD to BO (9).

> The officers of the Deccan survey...[were] constantly reminded that the...object of their labours was...a new assessment[1].

From July 1841 survey was extended to the South Marātha country, and later that year both Goldsmid and Wingate were granted furlough, charge of the surveys resting with Nash, who had five survey parties at work [367].

Though the surveys could never be adopted for topographical or geographical purposes, they were far more valuable for revenue purposes than those of the North Western Provinces already described, and, writes Markham, "proved so efficacious in promoting the revival of agriculture in the Presidency"[2].

Scattered surveys were carried on in Gujarāt, and in 1837 the Collector of Kaira reports very favourably of the work of his assistant surveyor, William Spry. He had been appointed in succession to one James Nock who had been discharged [278 n.4, 383]. The Collector considered the six Gujrāti surveyors under Spry

> a department of importance and great trust, ... in-so-much that the whole of the establishment are out surveying or superintending other works of a high nature eight months in every year. Nor are Mr. Spry's duties limited to these months ; he is liable at all times and on all occasions to be sent out at a moment's warning during the monsoons, to examine and report upon boundary disputes, tanks, drains, inundations, etc. In short, Mr. Spry has not been allowed to remain at headquarters at any length of time since he joined this office in August 1835. ...
>
> He was attached...first to the Acting Collector of Ahmedabad, then to Captain Outram in the Myhee Kanta[3], and is now only about to return to his duties here. Mr. Spry has thus been continually kept out on duty, and is always liable to be so[4].

Similar surveys were carried on in Surat District between 1832 and 1844, and later by "Mr. Assistant Surveyor and Builder, Mr. Kelly"[5].

TOPOGRAPHICAL SURVEYS, DECCAN & KONKAN

After the close of the Deccan and Konkan topographical surveys in 1830, Jopp, the Deputy Surveyor General, was left with a small staff of assistant surveyors and draughtsmen to finish off the mapping, and to survey a few small gaps. The only military officer left under his direction was Shortrede who was engaged on the trigonometrical survey and, writes Jopp in 1832, as this had not

> yet been pushed sufficiently north to enable me to compile the northern parts of the Duckun, or to finish the survey of two or three very small tracts which remain undone, I have employed the assistant surveyors [383]...in putting together, on 4 miles to an inch[6], many of the original surveys south from Poona, previous to their being copied for the Hon'ble the Court of Directors.
>
> The two apprentices are employed in copying such of the original surveys as were torn or otherwise much injured, and in improving themselves in drawing and printing, in which they were very deficient. ... So soon as the triangulation shall have been carried up to Khandesh, it is my intention...to send them into that province[7] [72].

Shortrede had fixed sufficient points in Northern Konkan by August, and Jopp obtained the Surveyor General's consent to send five of his draughtsmen[8] into the field to complete survey northwards to "the 20th degree of north latitude this season", whilst three assistants were sent into South Konkan to resurvey some areas "imperfectly done"[9]. Twelve months later he reported that

> the trigonometrical operations under Lieut. Shortreed not having yet been carried into the northern parts of the Dukhun where the detail surveys are incomplete, I have employed Mr. Aikin on the compilation of one of the sheets for transmission to your office. ...
>
> The two other assistant surveyors of the Dukhun Survey Department have been engaged... on the...survey of the southern Konkun. ... The extent of country...surveyed...I estimate... at from 1,800 to 2,000 square miles. ...

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[1] from Rev. Comnr. 15-2-41 ; *Poona Rev Svy.* (16-21) & *Rev Svy.* (*India*) (380). [2] Markham (135, 193) ; cf. *Roorkee Papers*, III, 1866 (84). [3] James Outram (1803-63) ; BO Inf. ; Mahi Kāntha, 1835-8 ; *DNB.* ; *DIB.* [4] from Collr. 22-4-37 ; BO RC. 840/1837 (241-3). *Bo Gaz. Kaira* (9). [5] BO RC. 181/1850 (11-17), from Rev. Comnr. N. Div. Ahmednagar, 10-12-49. [6] in degree sheets [306]. [7] DDn. 235 (35-9), 29-6-32. [8] Fraser, Springer, Wm. Aikin, DeCosta, and Bertie : MRIO. Misc. 11-PT.-33. [9] DDn. 235 (43), 17-11-32 (61), 1-5-33 ; N. Konkan, MRIO. Misc. 10-PT.-33, Wm. Aikin ; S. Konkan, MRIO. M. 377 1832-3, J. Aikin, Price, Sanger [383, 386].

> *Northern Konkun* Survey. I regret exceedingly that so much of the early and best part of the season should have been lost, for in the Konkun little can be done satisfactorily during the latter part of the season, for then the native burn their fields, and the clouds of smoke are... so dense as to render...all surrounding objects, very indistinct [75].
>
> None of the young men...had ever been so engaged before, but I accompanied them myself... to instruct them, executing a small tract in their presence before I assigned to each his separate portion[1]. ... I purpose...to send you fair copies of the work...on the scale of 4 miles to the inch. Owing to the difficult nature of the country, ... together with the...sickness of one of the party during...March, I do not estimate the extent...surveyed in the Northern Konkun at more than 2,500 square miles[2].

GUJARĀT & KĀTHIĀWĀR

Between 1836 and 1839 a survey was made by Henry Giberne of the wild hilly tract of Mahi Kāntha that lies in the north-east of Gujarāt, bordering on Mālwa to the east and Udaipur to the north. His survey extended also into Rewa Kāntha, a similar rugged tract lying to the south of the Mahi River. The survey was authorized by the Governor General in Council to cover

> the strong country between Guzerat and Meywar [Udaipur]. ... Much caution will be necessary to avoid causing suspicion and alarm to the wild inhabitants ; ... the proposed measure may possibly lead to unpleasant and troublesome consequences [245][3].

James Down [III, 439–40], "well acquainted with the natives of this country, and one in whose prudence...Government can confide", was not then available and as the country was then "in a distracted condition"[4] it was not until June 1836 that the Political Agent, James Outram, considered that the survey could

> advantageously be commenced upon. ... The maps and routes lent to me by Colonel Spiers[5], and...surveys taken during the late operations of our troops in the hills, together with the copy of General Reynolds' skeleton map, ... will enable me now to commence, ... and under the able superintendence of Lieut. Giberne, commanding the artillery with the field detachment, who has zealously volunteered his aid after the monsoon, I hope to obtain access to all remaining unknown portions of the hills, to enable that officer to complete the survey. ...
>
> The assistance of one or two native surveyors in addition to the draughtsman already applied for, and a supply of necessary instruments, will...enable Lieut. Giberne to proceed with the survey expeditiously[6].

Giberne was placed under the orders of the Political Agent, and the Chief Engineer provided the establishment ;

4 Lascars for carrying...instruments, @ 8 rupees per month each, for 12 months ...	Rs.	384
4 do. for an Assistant Surveyor, for 8 months in the year, as per regulations for the Engineer Institution [III, 384]		256
Batta to an Assistant Surveyor, @ 20 rupees per month for a year		240
2 Bullocks for the carriage of one Conductor's Tent, @ 5 rupees each		120
do. for private baggage, @ 5 rupees		120
Grain, forage, boy, and shoeing of a pony, for an Assistant Surveyor, @ 20 rupees per month		240
Total per annum ...	Rs.	1360

> The Chief Engineer...to select a youth from the Engineer Institution acquainted with surveying[7].

In October 1838 work was proceeding well and Giberne reported that he hoped

> during the next season to be able to construct a perfect map of Mhyee Kanta and the Barreah country [II, pl. 15] on trigonometrical principles. I have carried on the triangulation already to a great degree, and entertain great hopes...of being able to include very nearly the whole of the country. ... The country is...170 miles in length, and varies from 80...to 30...miles in breadth, and is for the most part thickly covered with hills, jungles, etc[8].

Outram reported in 1838 that little remained

> to complete the survey of the whole...frontier of Guzerat from the Nerbuddah to Mount Abu. ... The Quarter Master General at Neemutch[9] has been directed to complete what remains to be done on the Meywar side of the border [273]. ... This...has been effected...without a single

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[1] DDn. 235 (54–6), 14–5–33. [2] DDn. 330 (95–7) ; 16–7–33, 282 (403–9) ; 15–10–33. [3] B Pol C. 18–5–35 ; BO RC. 737/1836 (1–2). [4] *Bo Gaz.* V (383–4). [5] Alex. Spiers (1788–1847), Ben. Inf., Pol Supt. Ajmer, 1832–40 ; Hodson, IV (156). [6] from PA. 5–6–36 ; BO RC. 737/1836 & 39 (27–8). [7] BO RC. 737/1836 & 99 (47–50), 1–2–37. [8] from Giberne, Sadra, 23–10–38 ; BO RC. 737/1836 & 39 (181–2). [9] John Paton, AQMG. [III, 493].

> instance of collision with any of the chieftains or their followers, all of whom regarded the measure with extreme jealousy. ... This happy result is chiefly to be attributed to the...conciliatory manner with which Lieut. Giberne has conducted the undertaking[1].

Giberne claimed no high order of accuracy for his work[2];

> I only regret that it should have become necessary to remove me so soon from the survey, as I...hoped to have completed by the end of this year a map as nearly devoid of errors as, with the inferior instruments at my disposal, is possible. ...
>
> It is quite correct enough for military purposes, and far more so than any mere route survey. I measured a base roughly with a perambulator...the season before last, and one last season with a chain and two perambulators, ... on both of which I have partially triangulated the country, but as neither were satisfactory, I endeavoured to connect the...triangles observed in the Mhyee Kanta with those already laid down in the Rewa Kanta[3].

In April 1839 he was allowed to complete his survey of Rewa Kāntha.

Between 1835 and 1839 surveys were made in Kāthiāwār by Boyd and Benbow under the direction of the Political Agent[4]. "The tract between the Wurtoo and Bhadur rivers was surveyed and protracted by Hyum Essajie", who had been one of Jervis's sub-assistants in South Konkan [III, 393 ; IV, 309].

Sketches were made of roads from Belgaum to Dhārwār and Vengurla, probably on behalf of the Public Works Department, and of another from Panwell along the coast to Vengurla, by Indian guides employed by the Quarter Master General's department[5]. The following surveys were in progress about 1836–7 ;

> In Kattywar Captain Boyd is conducting the survey which was lately under the direction of Captain Benbow, who has gone to Europe sick.
>
> Lieutenant Giberne is employed in the Myhe Caunta. The examination of the Ghats and...country between Belgaum and Malwan has been assigned to Lieut. Hebbert of the Engineers [III, 448][6]. Lieut. Suart of the Engineers has been engaged this season in surveying the line between Bombay and Nagpoor, in the direction of the proposed grand road which... will pass over the Malsige Ghat, and through Jalna [269–70].
>
> Captain Forster and his establishment have been employed in surveying the roads, bunds, and tanks, and in other operations for the improvement of the country throughout the Deccan and Conkan ; and Lieut. Wingate, with a body of officers appointed lately to the revenue survey, is at work in the Poonah Collectorate[7].

SIND & BALUCHISTĀN

The period 1830 to 1843 covered great advances in the geographical knowledge of Sind[8], which had hitherto been hardly known but for the few political missions which had sailed up the mouths of the Indus to Hyderābād [II, 168–9]. The Indus was indeed the great highway by which Sind could be traversed from south to north, the country being protected on the east by the inhospitable desert, which had been crossed only at the rarest of intervals, as by the intrepid Indian explorers sent out by Reynolds [I : 132, 246 ; II, 353], and more recently by James Burnes, who rode across from Cutch on an errand of mercy [III, 131].

The Indus had long been a river of mystery suggesting a possible avenue from the sea to the Punjab and the mountains ; European travellers were, however, unwelcome to the Mirs of Sind. It was to avoid Sind that Alexander Burnes had attempted in 1829 to reach the Indus across Rājputāna from the direction of Ajmer, but had been recalled by orders from the Governor General [III, 132–3]. His opportunity was not long delayed. Negotiations were in train between the English throne and Lahore, and in 1830, writes Burnes,

> a ship arrived at Bombay with a present of five horses[9] from the King of Great Britain to Maharaja Runjeet Sing, ... accompanied by a letter of friendship. ... On the recommendation of Major-General Sir John Malcolm [III, 483–4], then Governor of Bombay, I had the honour

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[1] BO RC. 137/1836–9 (177–9). [2] MRIO. 83 (53) ; map from svys. by Paton & Giberne ; *IO Cat.* (456) ; two of them drawn by Spry ; Bo Pol C. 1838 (228). [3] Bo Rev C. 737/1836 & 9 (222–4) ; 24–11–38. [4] scale 2 miles to inch ; *IO Cat.* (455). [5] MRIO. 118 (1, 2, 29). [6] Wm. Geo. Hebbert (1810–85) ; BO. Engrs. 1829–55. [7] *Bo Geo Soc.*, I (389). [8] according to Burnes, Sind—Hindu—Indus—all derive from same root word ; *JRGS.*, VII, 1837 (11). [9] dapple-grey shire horses ; *Bokhara*, I (88).

> of being nominated...to proceed...to the Seik capital with these presents by way of the river Indus. I held at that time a political situation in Cutch. ...
>
> The navigation of the Indus is important in every point of view, yet we have no information that can be depended upon, ... except of about seventy miles from Tatta to Hyderabad. ... The only accounts of a great portion of its course were drawn from Arrian...and the other historians of Alexander's expedition [I : 220]. ...
>
> A young, active, and intelligent officer, Ensign J. D. Leckie, of the 22nd Regt. BO. N.I., was...to accompany me. A surveyor[1] [and] a native doctor, ... were likewise entertained. ...
>
> We sailed from Mandivee in Cutch with a fleet of five boats on the morning of 21st of January 1831. On the evening of the 24th we...anchored in the...eastern...branch of the Indus, which separates Sindh from Cutch. ... We followed the Sinde coast for four or five days. ... At nightfall on the 28th we cast anchor in the western mouth[2].

After waiting several days they were refused permission to proceed up the river, and had to return to Māndvi ;

> The conduct of the Ameer...was most unfriendly. ... He magnified the difficulties of navigating the Indus, and arrayed its rocks, quicksands, whirlpools, and shallows, in every communication. ... In his estimation we were the precursors of an army. ...
>
> On the 10th of March we once more set sail for the Indus, and reached...one of the central mouths of the river after...seven days. ... [After] a week's negotiation...we quitted Tatta[3] on the morning of the 10th of April, ... embarked in flat-bottomed boats...and commenced our voyage. ... On the morning of the 18th we moored opposite Hyderabad. ...
>
> We marched to Bukkur on...the 19th [May], ... a fortress 15 miles from Khyrpoor, situated on an insulated rock, ... with the town of Roree on the one side and Sukkur on the other [245]. ... On the 30th of May quitted the Indus at Mittuncote...and entered the Chenab. ... Left Ooch, junction of Beas and Sutlej with the Chenab, on June 6th.

In describing the Panjnad, the link between the Chenab and the Indus [244], Burnes tells of "several decayed canals" that,

> if cleared, would yet lead the water of the Chenab to the Indus, and may account for Major Rennell's conducting that river into the great stream so many miles above the true point of union, until the geographical error was rectified by the mission to Cabool [II, 65–7, IV, 244][4].

Sind had now been left behind, and on 15th June they reached Multān.

> At noon on the 17th of July we came in sight of the lofty minarets of the King's mosque at Lahore...and the termination of our protracted voyage, but the ceremonial of our *entrée* required arrangement, and we halted 3 or 4 miles from the city at the earnest request of our conductors. As the sun set, I saw for the first time the massy mountains which encircle Cashmer, clothed in a mantle of white snow. I felt a nervous sensation of joy as I first gazed on the Himalaya [I : 76 ; II, 84–5].
>
> On the morning of the 18th...we made our public entry into Lahore. ... We were introduced... by Captain Wade, the political agent of Government at Lodiana [III, 510 ; IV, 281][5].

With his map Burnes submitted a "geographical memoir"[6] ;

> The map...rests on a series of observations by the stars taken each night. I should have preferred altitudes of the sun, but with a people so suspicious...it was impossible to use an instrument openly in daylight [275], and I should have required to halt the fleet twice to procure equal altitudes, since the sun was south of the equator. ... Many of the large places... have been laid down from a mean of 8 to 10 stellar observations. The longitude and...curvature of the river rest on a minute protraction of its turnings, carefully observed every half-hour and sometimes oftener, with the approved compass by Schmalcalder [III, 132 ; IV, 277][7]. ...
>
> My fieldbooks exhibit on an average twenty bearings each day between sunrise and sunset. I was early enabled to rate...the boats...by timing them on a measured line along the bank. ... We could advance...by tracking, or being pulled by men [394 n.7] at half a mile an hour, while any great excess or deficiency was pointed out by the latitude of the halting place.
>
> The base on which the work rests is the towns of Mandivee and Carachee...which we saw before entering the river. Mandivee stands in the latitude of 22° 50′, and Carachee in 24° 51′ North, while their longitudes are respectively in 69° 34′ and 67° 19′ East, as fixed in 1809 from the chronometers of the Sindh mission by Captain Maxfield [II, 168–9].
>
> Assuming these points as correct, the line of coast...has been laid down from my own Map of Cutch [III, 131], ... while that of Sinde rests on observations of the sun's altitude at noon, and the boat's daily progress determined by heaving the log hourly. We sailed only during

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[1] possibly Muhammad Ali [274]. [2] *Bokhara*, I (1–10). [3] old capital of Sind, on Indus, 60 m. E. of Karāchi ; Burnes found discharge of Indus at Tatta 80,000 c. ft. per sec. *JASB.*, I (2–3). [4] *Bokhara*, I (85). [5] ib., III (22–148). [6] ib., I (195–328). [7] *JASB.* III, 1834 (287).

> the day, and at all times along shore, often in a small boat, and were attended by six or eight pilots who had passed their lives in the navigation of these parts. ...
>
> I can bear testimony to the correctness of such portions of the Indus as were... traversed by the mission of 1809 [II, 168–9]. From the jealousy of the government of Sinde we had to pass up and down the coast no less than five times, which gave ample opportunities to observe it. ...
>
> In delineating the delta...below Tatta, I have not only had the advantage of sailing by a branch to that city, but approached it on land by one route and returned by another. I also ascended the Piltee, or western mouth...for thirty miles. The opposition experienced from the Scinde Government gave rise to these variations of route. ... Their vacillation has happily added to our knowledge of their country. ...
>
> In addition to my own track I have added that of the Sinde Mission from Curachee to Hyderabad, and thence up to Lucputt. ... From Hyderabad upwards...the different towns rest on the latitudes as determined by the sextant. Most of them are in a higher parallel than in the maps, but it was satisfactory to find, on reaching Ooch, that the longitude of that place, as taken from my own protraction, coincides with that which has been assigned to it by Mr. Elphinstone's surveyors, who must have fixed it from Bhawalpoor [243].
>
> This was not the case with Bakkur but, as the latitude of that place was 22 minutes below the true parallel, I have reason to be satisfied with the result. I likewise found that the Indus receives the Punjab rivers at Mittun in the latitude of 28° 55′ instead of 28° 20′, as given in the Map of the Cabool Mission, but no one can examine that document without acknowledging the unwearied zeal of its constructor[1] and wondering that he erred so little when he visited but few of the places [II, 270–1 ; IV, 277, 279]. ...
>
> The Punjab rivers have been laid down on the same principle as the Indus. The Chenab, ... which has been erroneously styled the Punjnud after it has gathered the other rivers, is very direct in its course, but the Ravee...on the other hand is most tortuous, and appears in its present shape on the map after incredible labor for 20 days. The latitude of its junction with the Chenab, and that of the extreme point of the map, the city of Lahore, which stands in 31° 35′ N., and in 74° 20′ East longitude[2], have materially assisted me in the task.
>
> I have also placed the confluence of the Jylum...with the Chenab twelve miles above the latitude in which it has hitherto stood. The survey eastward terminated on the left bank of the Sutlege...with the British cantonment of Loodhiana, which I find stands in 30° 55′ 30″ North latitude. I have used the longitude of the latest and best map, and placed it in 75° 54′ East[3].

In 1831 Henry Pottinger conducted a mission to Sind [II, 437–8] and "concluded a treaty with the Hyderabad Mirs...by which traders and merchants were permitted to use the roads and rivers of Sind, though no Englishman might settle in the country"[4]. As a consequence of this treaty an "Indus Steam Navigation Company" was formed in England, but trade did not prosper [278][5].

Pottinger had his brother William on the mission staff, who made various small surveys and compiled a general map, but the official surveyor was Edward De l' Hoste, who left several maps and sketches, and a Journal[6] in which he records that the mission left Māndvi on 29th December 1831, the last entry being made at "Muggurbhee" on 6th May 1832[7]. He gives a good description of the country, and of the Indus he writes ;

> The sources of this great river are hidden ; ... it rises in the mountains of Himalaya near Thibet. It is probable that the Shyook from Karkorum and the river of Ladak from near lake Munsurour are its feeders. ... From Attok to the sea the Indus is familiarly known by the name of "Scinde" or "Attok". Mehran is a name only known to foreigners [I : 234 ; pl. 4, n.].

On 26th November 1836 Burnes again sailed from Bombay to journey up the Indus, this time to take up the post of Commercial Agent at Kābul. He landed in Sind, 13th December with Robert Leech and John Wood and was joined at Rohri by Dr. Percival Lord. A detailed survey and memoir of the Indus was maintained from the sea to Attock [277–8][8].

For the march against Afghānistān in 1838, Sind was freely used for the passage of troops and military stores, contrary to the treaty of 1831. Throughout the campaigns the *amirs* remained friendly, but by the autumn of 1842 the situation

[1] John Macartney [II, 418].

[2] true position, 31° 33′ N. ; 74° 22′ E.

[3] Map of the Indus & Punjab rivers, from the sea to Lahore, Burnes, Ludhiāna, 1–12–31 ; DDn. 281 (7–17) ; *IO Cat.* (136).

[4] *Imp Gaz.* XXII (400).

[5] *Cabool* (329–35).

[6] MRIO. M 217–8, with 1-inch sketches ; cf. BM Addl. MS. 14382.

[7] Map of Sind, Sukkur to Sea ; sd. 19–7–32 ; MRIO. 120 (1) ; *IO Cat.* (447).

[8] *Cabool* (5, 304–68) ; *Reports on Navigation of Indus* : paper by Wood read 24–6–36 ; *Bo Geo Progs.*, II (72).

deteriorated and, after Sir Charles Napier had taken over civil and military control, a treaty was forced on them under which they had to cede several towns, and " a strip of land on each bank of the river ". The battle of Miāni, 17th February 1843, was followed by the annexation of the whole country by the British.

From 1839 military surveyors had been traversing Sind in all directions. A survey of Karāchi and surrounding country, showing camps of various military units of the Bombay column, was signed by George Boyd on 7th May 1839 [III, 426][1]. A plan of the island and fort of Bukkur, with a fine panorama, shows "the position of the military bridges thrown across the Indus for the passage of the army under Major General Sir W. Cotton on Feby. 14th 1839", scale 200 feet to an inch[2].

In 1840 George Le Messurier [III, 473], A.Q.M.G. and superintendent Sind Survey 1838–42, submitted a journal of his route from the direction of Cutch

> through...the Thurr [desert] and part of Scinde, ... via Islamkote and Amerkote to Hyderabad. ... As the open use of surveying instruments was considered objectionable, and likely to alarm and excite...a people amongst whom Europeans had hitherto never appeared, I... confined myself to...a pocket compass, and the occasional use of a sextant to determine the latitudes ; but this last, ... through some imperfection...which I only discovered at Omercote, I cannot depend upon.
>
> The distances were determined by the rate of a camel's pace, both ambling and walking, ... comparing minutely with a good watch and perambulator for five days over a varied country. ... The establishment of a camel dak between Hyderabad and Deesa[3], and the best routes to be adopted for the dak to travel at all seasons was a subject you directed my attention to.
>
> I have...detached a guide of the Quarter Master General's Department to survey...the route between Amerkote and Balmeer[4], ... I propose to send a skeleton map with...the routes to be taken by the camel dak from Hyderabad to Deesa[5].

In forwarding these sketches Outram, the Political Agent, urged that

> a survey is necessary to strengthen our military position in this country, which must ever be considered weak while our only communication with India is by sea in the fair season, and totally cut off during the monsoon. ... I would not recommend, however, that the survey of the eastern portion of Sinde should be commenced upon until the Chiefs...have been prepared, ... but...the officer...should be a person of experience, in whose discretion I could implicity rely. ...
>
> I have no hesitation in recommending Captain Le Messurier...for, in addition to his knowledge of surveying, acquired by long practice in the Deccan survey [III, 125, 473], ... that gentleman is peculiarly qualified for the trust by his mild temper, conciliatory manners, knowledge of natives, and of the Persian and Indian languages.
>
> That officer is...to perform the duties of the Quarter Master General's Department in Sinde, ... but...could, with an adequate establishment, conduct the survey at the same time. ... In the first instance the survey might be confined to the plains of Sinde, but to the western side of the Indus, until I am prepared to authorise his crossing to the eastern, and afterwards might be extended...northward, until connected with the survey now in progress in Afghanistan[6].

Later in the year an interesting journey was made by De l'Hoste from Ahmedābād to Sukkur, marching with his regiment ;

> Adaulij, 17th August [1840]. Arrived here this morning, and joined left wing of 9th Regt. N.I., proceeding to Deesa to relieve the 6th Regt., which I am to conduct by the route I consider best to Sukkur. ... Halted Deesa 22nd to 28th August. ... Rumpoora, 28th. ...
>
> Thurraud, 1st September ; large place. ... Bokney, 2nd. ... The corps marched here this morning. By crossing the Runn (which is dry)...3 marches will be saved.
>
> An officer of the regiment...(Lieut. Landon[7]) caught one of these animals [wild ass] when very young, and completely tamed it, so far that the animal followed him wherever he went, and came to him when called, but no perseverance or pains would induce the beast to carry either a man or a load. He would, although perfectly gentle at other times, on those occasions bite and kick until he threw his rider, or if unsuccessful lie down, and neither good nor ill treatment would induce him to rise. His affection for his master was remarkable. If when tied up he happened to see him at a distance, the noise and struggles he would make to get free were tremendous. I have known him follow his master to parade, and change flanks with him, following him closely to the no small amusement of the sepoys.

[1] MRIO. 190 (6), 3 inches to mile. [2] MRIO. 190 (9) ; sd. by Neil Campbell, QMG. to Bo. force. [3] 40 m. sw. of Mt. Abu. [4] Barmer, in Jodhpur State. [5] DDn. 407 (30–2), 4–3–40 ; Map, MRIO. 117 (12). [6] Hyderābād, 2–4–40 ; DDn. 407 (26–9) ; to Pol Dept. G of I. [7] Samuel Landon, of Deccan Rev. Svy. [367, 369].

> **Tariana**, 23rd September. ... Omarkote, 1st October. ... By observation I make Omarcote in 25° 19′. I may be wrong, as a pocket sextant & false horizon are not easy instruments to use for such observations. The sextant with stand would have given me a true observation, but I have not one.
>
> **Dadera** or Dundi-i-Khalifa, Monday 12th October. ... We had a fearful march of it to-day; the guide mistook the road, and led us through valleys in which the jungle was so thick that we could hardly get through it; and over steep hills of sand which seemed to continue for ever. **Tramore**, 21st. ... It is now only 14 miles to Roree, where we proceed this evening[1].

Another survey of the route from Deesa[2] was made by John Jacob who later distinguished himself in political service. Amongst his many other surveys is a "Sketch of part of Upper Sind, showing Nufory Pass and country to south"; this shows a profile of the pass, and is dated 15th February 1840[3]. Other reports and maps of Upper Sind were made by Thomas Postans, a well known political officer[4].

A map of the roads in Bombay Presidency surveyed by officers of the Quartermaster General's between 1840 and 1842[5] includes a number surveyed during the Afghān campaigns, and a Map of Sind, compiled in the Surveyor General's Office[6] bears acknowledgement to the following surveys [284];

1. Survey of Sind between Sehwan and Shikarpur, the River Indus, and Hola Range, including Cutch. Lt.-Col. Neil Campbell, Q.M.G. Bombay, Aug. 1840. 4 m. to inch.

2. Survey of Lower Sind; Q.M.G. Bombay, 1838 to 1840. ...

4. Sketch of Indus from Shikarpur to sea, including Cutch, from works of Lt.-Gen. Reynolds, &c. sd. J. Jopp, ... June 1831; 10 m. to inch.

5. Plan of Kulleree...canals, by Captn. Geo. P. Le Messurier. Scale 1 m. to inch.

6. A general sketch of proposed communication from Indus River to Karachi Harbour, by Captn. G. P. Le Messurier, scale 4 m. to inch.

7. Route...from Hyderabad to Umarkot, surveyed by Captn. Le Messurier; Umarkot to Balmeer, surveyed without instruments by a Guide of Q.M.G.'s Department. ... Scale 4 m. to inch [245][7].

8. Map of Sind, ... Sukkur down to sea; Edward P. De l'Hoste, surveyor to the Sind Mission, 1st August 1832. Scale 8 1/3m. to inch. The line of coast is taken from Lt. Burnes' surveys [244][8].

9. Map of the route of the Army of the Indus, by Lts. Durand and Anderson, Bengal Engineers, 1839. Scale 10 m. to inch [281–2].

10. Map of the Indus and Punjab Rivers, from the sea to Lahore, by Lieut. Alex. Burnes, on a mission to Lahore in 1831. Scale 8 m. to inch [242–4].

11. Map of south portion of Rajputana, by Lts. Alex. Burnes and J. Holland, Q.M.G. Department, June 1830. Scale 12 m. to inch [III, 132–3].

12. Chart of the Indus from Hyderabad to the sea. Lt. T. G. Carless, Indian Navy, 1836 [*inf*].

13. Routes Kotri, near Hyderabad, to Sehwan, thence to Larkana, March 1839; Hyderabad to Tatta, Feby. 1841; Tatta, south-west to Vikkar Bunder, Dec. 1838; ... by Q.M.G's. Department[9]. ...

14. Skeleton map shewing the principal routes through Thar (Sind), showing...Captain Le Messurier's... route from Hyderabad...to Deesa. Scale 10 m. to inch. ... Bearings taken with pocket compass. Distances estimated by a camel's paces [245].

15. Engraved map of Central Asia, constructed from Lt. Alex. Burnes' M.S. surveys, and other authentic documents, by John Arrowsmith. June 1834. Scale 70 m. to inch [277].

Before the annexation surveys had been started for the lay-out of canals by William Baker from the North-Western Provinces, and in 1843, it was suggested that Du Vernet should be transferred to assist, but he could not be spared from the Great Trigonometrical Survey[10].

COASTAL MAPS

Of coastal maps, mostly from surveys by officers of the Indian Navy, or Bombay Marine Service as it was called before 1827, a comprehensive account is given by Markham. A less precise account is given by Low[11].

From 1836 to 1838 Thomas Carless of the Indian Navy surveyed Karāchi and the coast from the eastern mouth of the Indus to Somniāni Bay, "laying down buoys and erecting beacons to facilitate navigation"[12].

A report of 1862 states that Henry Pottinger's map of 1814 [II, 174] was used in the preparation of later maps. ... Arrowsmith's map of 1834 seems to have been taken from Pottinger's, with information from Haines' nautical chart of 1829 [III, 133]. The latter as a chart of the coast is of great value, but deficient in minor land detail. ...

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[1] *Bo Geo Progs.* 1839–40 (145–68). [2] MRIO. 118 (15). [3] HMS. 552 (34–5); MRIO. 112 (65), 121 (35). [4] *JASB.* XII, 1843. [5] *IO Cat.* (418). [6] MRIO. 120 (3), 8 m. to inch. [7] ib. 117 (33); 160 (2, 3). [8] ib. 120 (1). [9] ib. 117 (13–21). [10] DDn. 401 (274), 14–7–43. [11] Markham (14–30); Low, II (83). [12] *Bo Geo Progs.*, I (374), MRIO. 92 (16, 17).

The plan of the Coast of Mekran from the Indus to the Persian Gulph, copied from a MS. compiled by Mr. Dalrymple in 1795 is of singular accuracy; it was prepared from material collected by Lts. Robinson, Porter, Blair, & Mascall...nearly 90 years ago [I : 313][1].

A Map of Maritime Arabia, including "the opposite coasts of Africa and Persia", was reduced in the office of the Q.M.G., Bombay, in 1855, from "an original map by Col. T. Dickinson, Chief Engineer", signed on 4th April 1843. The title-piece shows an Arab scene, and a note acknowledges

> Gulf of Persia & Arabian Coast, from engraved chart, 1830, from trigonometrical surveys by Capt. Brucks & Officers of the Indian Navy, 1821–29 [III, 133 n.1].
>
> Arabian Coast from engraved chart of Oman, and survey of interior by Lieut. Wellsted of Indian Navy[2].
>
> Islands of Kooria, Ras Sherbad, and Ras Noos, by Captain Haines & Lieut. Sanders, I.N., 1837[3].
>
> Entrance of Red Sea, by Haines, 1839, and Moresby. ... Red Sea Coast, etc., engraved charts, 1820–33, by Elwon, Moresby, Carless, Pinching, I.N.
>
> Route across Peninsual, El Katif to Yamboo[4] Capt. M. Houghton, I.N.; Journal of Capt. Sadlier, 1820–33, 1819; Burchardt's published map of 1829.
>
> Mocha to Eena; engraved sketch by Dr. Hutton and Lieut. Cruttenden, I.N., 1836. *v.* Tassin's map, also Capt. Hamerton's sketch 1840.
>
> Coast of Mekran. Capt. Kempthorne's chart[5].

There are also preserved a Portuguese military map of the Island of Diu, in two sections, bearing dates between 1833 and 1864[6], and a map of the Tigris from Basra to Baghdād, compiled on scale 12¼ miles to an inch, from survey by Ormsby and Elliott, with another section from Baghdād to Mosul.

Burnes has left the following tribute to Indian seamanship;

> Among the timid navigators of the East, the mariner of Cutch is truly adventurous. He voyages to Arabia, the Red Sea, and the coast of Zanguebar [Zanzibar ?] in Africa, bravely stretching out on the ocean after quitting his native shore. The...pilot determines his position by an altitude at noon, or by the stars at night, by a rude quadrant. Coarse charts depict to him the bearings of his destination, and by long-tried seamanship he weathers...the dangers... of the Indian Ocean.
>
> This use of the quadrant was taught by a native of Cutch, who made a voyage to Holland in the middle of the last century, and returned...to enlighten his country with the arts and sciences of Europe[7].

Prinsep describes a simple instrument used by Arab seamen which comprised

> a small rectangle of horn, either running on a rod, or connected by a knotted string, the angle of elevation of the Pole star being measured by the distance from the eye at which the width of the rectangle fills the space between horizon and star [I : 151][8].

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[1] HMS. 551 (567); Report by F. J. Goldsmid. [2] *JRGS.* VII. [3] ib. X. [4] *Bo Lit Soc.* 3. [5] L. R. Hall's Atlas of 1830. [6] MRIO. 92 (16); 177 (12); probably between 1830 and 1832. [7] *Bokhara,* I (6): cf. Bagrow's account of *The Vasco Gama Pilot,* a "Moor" from Gujarāt. [8] *JASB.* V. 1836 (784–94).

CHAPTER XV

MADRAS SURVEYS

Organization — Madura, Trichinopoly & Salem — Ganjam — Nellore — Nizām's Territories — Professional Details — China, 1840–2.

THANKS to the sound organization that Mackenzie had given to the Madras surveys, and the close control maintained by Mountford and Montgomerie, survey was carried steadily forward until every district was furnished with satisfactory maps and valuable memoirs. Those still in hand in 1830 were—

Hyderābād, or the Nizām's Territories, under Henry Morland, commenced by Garling in 1816, and only just completed fifty years later.

Madura District, commenced by Benjamin Ward in 1830, the party moving to Trichinopoly in 1832, and to Salem in 1835.

Northern Circārs, commenced in 1815, and from 1820 under Charles Snell. Having completed the coastal area northwards into Ganjam, the party moved to Nellore during season 1832–3.

Since 1824, Montgomerie had held charge as Deputy Surveyor General of the field parties and the drawing office, with the recruitment and training of apprentices [III, 321 ; IV, 381]. After the closing of the branch offices at Madras and Bombay in 1833, the more important maps and records were transferred to Calcutta, the remainder being deposited with the local Chief Engineers [328].

Though the Madras parties now came under the direct professional control of the Surveyor General, appointments of officers and establishment remained with the local government, who were also responsible for discipline, pay, and equipment, and, except for Hyderābād, for all expenses. Everest was so deeply engaged in the work of the Great Arc that he could exercise little control over these parties, and in 1840 deputed their charge to his deputy at Calcutta [317, 325].

The Hyderābād Survey had worked under the political control of the Resident who corresponded with the Supreme Government in Bengal, so that except for personnel this survey had little to do with Madras. In 1831 Everest asked that it should come under his direct control as he knew the country so well[1] [III, 442–5].

The transfer was approved, and from July 1831 till April 1840 reports were sent direct to the Surveyor General, being thereafter sent to the Deputy Surveyor General at Calcutta. Morland held charge from 1829, with frequent intervals, till his promotion to Major in 1848, when the survey was still far from complete.

By 1840 the Nellore and Salem surveys were drawing to a close. Campbell, in charge at Salem, was ambitious and energetic, and most anxious to turn the energies of his staff to geodetic, geological, or revenue surveys, but the Surveyor General would not hear of such misuse of a topographical party [258–9]. A long discussion then followed as to whether to employ these parties on the resurvey either of "the Jawaddy Hills" in North Arcot, or of north Coimbatore, or whether they should take up work in the Nizām's territories.

> With...three parties kept efficient and actively employed, Captain Morland states that the remaining portion of the Nizam's Territories would probably be surveyed in about five years. ...
>
> I...suggest...that Captain Morland...be placed in general charge, and that his salary (now 350 per mensem only) be raised from the 1st January 1841 to 526 per mensem, or the average of a full surveyor's established allowance [365][2].

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[1] DDn. 265 (118), 10-1-31.

[2] DSG. to Mil Dept., 28-11-40 ; DDn. 408 (97–9).

Government was doubtful as to the wisdom of surveying the Nizām's territories at all; "Mr. Prinsep, who leads the Council in geographical matters [101], is asking the 'cui bono' of such extensive work in a half-independent State, when so much country under our own immediate jurisdiction requires to be better known"[1]. The Surveyor General was asked to make a full report on the work of the Hyderābād party, with reasons for maintaining it in that particular area, and whether its work was good enough for the Atlas of India [20, 298].

> The Resident at Hyderābād has furnished a statement of the sums issued from his treasury on account of this survey, and though the account does not include payment made at Madras, and the issues of near six years from 1822 to 1828 are altogether omitted, the amount expended... is...Company's rupees 3,37,688 [256]. ...
>
> The Survey party having been organized by the Madras Government, ... the charges were for some time after the appointment of one Surveyor General for all India borne in the accounts of that Presidency. The bills and monthly abstracts seem still to be rendered to Madras, but the charge is there transferred in account to the Government of India. ...
>
> Although the responsibility for the institution of this survey attaches to a period when the system...was different, the control...has been vested in the office which you have filled for the past ten years. The Government had therefore a right to expect that the survey would have been put under such efficient regulation by your direction, not only to ensure a full equivalent of work for the money expended, ... but to provide also that it should be conducted according to the system best adapted to the end in view. ...
>
> If the formation of a general map of India is to be attempted by survey parties of this description, their work should be laid out annually by the Surveyor General, and the result reported to the Government of India at the end of each season, ... and although some of the parties may with advantage be composed of...officers borrowed from other Presidencies, ... the appointments to the survey should be made by...the Governor General in Council, the correspondence passing through your office.
>
> In the case of the Hyderābād surveys this rule has only been partially followed, and the Government of India has had no periodical reports. ... Although, too, the expense has for some time been charged to this Government ultimately, ... the bills and abstracts seem to have been passed by the Government of Fort St. George, ... all of which is objectionable, and should not have continued after the survey was placed under your control[2].

It took Everest a full year to collect material for his reply. He then pointed out that the survey had been started under the directions of the Madras Government as a contribution to the general geography of India. It had been strongly supported by the Resident at a time when there was profound ignorance of the geography of the greater part of the territories, and when maps were urgently required for military defence against *pindāri* incursions [III, 114–5]. There was on the other hand no demand for survey from the Nizām's government. Though the cost of survey fell on the Supreme Government, its necessity had not hitherto been questioned, and had been accepted by the Court of Directors. It served no purpose except

> to furnish materials for the...Atlas, nor can I divine any other. ... I have never received any intimation...[of] what might be the real causes of this minutely detailed process in a foreign territory. ... As the field for survey...it had been covered over with a net of principal triangles between 1813 and 1822 [II, 249; III, 227–32; pl. 18]. ...
>
> The Sirkars of Kummummett, Warungul, and others to the eastward of the Great Arc Series, include perhaps some of the most deadly tracts in India. They have been a grave to the members of the Survey Department and seriously injured the health of all engaged in them [III, 231–2]. Moreover those tracts, though exhibiting remains of former populousness in the days perhaps when Tellingana flourished under its native princes, consist now of forests almost interminable, and would not seem to be worth the cost of an accurate detailed survey. ...
>
> There is abundance of territory belonging to the H.E.I. Company yielding an ample revenue, which would seem much more worthy of the cost and toil than the dominions of of his Highness the Nizām. But...it is much easier to destroy than create efficiency. A vast deal of time, cost, and labour, are always expended in training a new establishment, and the parties employed in....the Nizam's Dominions have already undergone that course.

He discussed the wisdom of closing down the survey, and moving the party up to Bengal to survey the country now being covered by the subordinate meridional series to the east of the Great Arc, but it was decided to leave this area to the Revenue Surveyors [210–34, 261–2], and to carry on the survey of the Nizām's Territories[1]. It was not, however, until 1842 and 1844 that orders were issued for the disbandment of the Nellore and Salem parties, the military officers being reverted to their units, and the civil staff distributed to other survey parties [253, 255, 259].

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[1] SG. to Morland, 15–12–40, DDn. 389 (21). [2] from Mil Dept., 30–12–40; DDn. 407 (175–86).

The Ganjam survey was a different matter. About a year after the withdrawal of Snell's party [253, 255], Thorold Hill was recalled for a military survey into the hills, and from 1836 was continuously employed on survey of the hill tracts of Goomsur. A large area of this difficult unhealthy country was still unsurveyed when he had to take sick leave early in 1842. His survey was not based on regular triangulation and was later entirely superseded. It was, writes Bedford,

> neither under myself or the Surveyor General. On receiving charge lately from Captain Hill, his successor applied to me for instructions. ... I forwarded his letter to the Surveyor General, and in reply was told that he could issue no orders as the survey had been got up by the Madras Government quite independent of him. Captain Hill is said to be embarking for Europe. ... The Ganjam survey appears a perfect amateur affair[2] [255].

When Everest left India all field survey in the Madras Presidency had come to a close [10].

MADURA, TRICHINOPOLY, & SALEM

In April 1830 Benjamin Ward moved his party, with Du Vernet as assistant[3], to Madura, where survey was completed in 1832. Trichinopoly was taken up after the monsoon, and field work there was completed by about April 1834, and the final maps submitted by May 1835[4].

Having been promoted to the rank of major, Ward was ordered to rejoin his military unit [III, 512], and handed over to Thorold Hill at Trichinopoly on 1st November 1834. Ward was the last of Mackenzie's officers, and a very fine topographical surveyor, with long experience of work in heavily wooded hills. Since 1816 he had held charge of the surveys of Travancore, Dindigul, the Nīlgiri Hills, Malabar, Madura and Trichinopoly. His senior assistant, Charles MacMahon, had been with him all through [III, 105–14].

The party started field work in Salem District in March 1835[5], Hill taking up the triangulation in May. In the few months left that season about 850 square miles were completed covering "the course of the Cavery for about 41 miles, and the whole of the Colleemullay Range, commonly known as the Shandamungalum Hills, and of which little has hitherto been known"[6].

In January 1836 Hill was called to military duty in Goomsur [*sup.*, 253], being joined by Howard six months later. John Campbell took charge in April, but after two months was himself recalled. MacMahon then carried on field work right through the year, reporting that during field-season 1835–6

> upwards of 2,000 square miles...has been defined with great minutia with the planetable, ... founded on...the Great Trigonometrical Survey. The terrace land called the Cullery and Jadagoundum mountains, rising to an elevation of about 4,000 feet above...the sea, hitherto so very little known, has been explored and surveyed in detail, together with portions of the... talooks in the plains, and of...the Baramahl; the whole...between the latitudes of 11° 15′ and 12° 40′ North, and 77° 50′ and 78° 50′ of east longitude. ...
>
> The...mountains...are densely peopled by a class of hill tribe called Malayalers, who are permanent residents confined to agricultural pursuits. ... The rich and beautiful production of dry grain vegetation on this interesting table-land is of an insular character. ... About the locality of Salem, the hills are intersected by veins of magnesite, a mineral which has of late years attracted attention with naturalists. ...

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[1] DDn. 402 (197–207), 13–12–41.
[2] from DSG. to Morland, 13–1–42; DDn. 389 (69–70).
[3] tr. to Hyderābād Dec. 1832.
[4] trig. chart, *Ben Regr.* 594 (64); maps, MRIO. 147 (35–6), submitted in March 1833. *IO Cat.* (400); triangles, village regrs., road svys., Trichinopoly, MRIO. M 9, 10, 94; maps, ib. 147 (26–9); 137 (26); DDn. 387 (19), 26–5–34.
[5] MacMahon, Howard, Boyne, Brunton, Allen.
[6] DDn. 286 (2 28–35); 31–10–35. Journal, MRIO. M 100, 1–9–35; maps, MRIO. 135 (12–21), completed 1840–2.

> The unconnected state of the survey...was caused by the ill-health of some of the party, which rendered it necessary to employ their services for a time in the Baramahl to avoid the inhospitable hot season below the Ghauts[1].

Campbell resumed charge during 1837 reporting 1,840 square miles for 1836–7;

> The Shevary mountain is...most conspicuous and extended, throwing out in almost every direction minor branches and ridges, particularly to the north, where it emerges into the prolongation of the Tappoor Ghauts. ... The elevation of this terrace is nowhere above 5,260 feet from the plains, and the...smooth almond-shaped hills, with the over-grown...thickets, ... densely covered with permanent foliage as if artificially produced, characterize the appearance of hills very similar to that of the Neilgherry[2].

He reported 2,218 square miles for 1837–8,

> the work of only nine month in the field, as the Survey went into quarters on the 9th October 1837 for shelter during the monsoon, which fell very heavily[3], ... and did not take the field again until the 9th of January, during which time the sub-assistants were...finishing the colouring of their respective plane-table draughts, and entering the names, ... as the draughts had been set aside unfinished from the commencement of the survey four years ago, to allow the work to be got on with quicker.

The northern border with Mysore followed broken rugged country,

> elevated about 2,500 feet above the sea. ... From it rise abruptly high naked gneiss rocks... of a rounded mammillary form, ... crowned with numerous hill forts of considerable strength, constructed by the former independent Poligars [II, 181], but which are now in ruins.
>
> Others of these gneiss hills are formed of huge masses of rocks piled on one another, or shooting up into fantastic spires, while the bases of all are surrounded with jungle growing among the debris of the softer portions which have disintegrated and fallen from the summits. In some parts the diluvial soil contains so large a portion of quartz and felspar as to make it unprofitable for culture. ...
>
> The portion surveyed...between the town of Denkencottah and the Cavery River[4] is a mountainous tract, almost a neglected jungle, in which elephants, bison, and tigers roam unmolested. Some of the mountain summits rise 4,000 feet directly from their base, and to about 5,000 feet above the sea. They are mostly of sienite granite and trap rocks, and the upper part of some is flat, and is covered with arable land.
>
> Among these mountains are...fine fertile and highly cultivated lands, and also deep glens, many of considerable beauty, in which under the Moslem rule[5] many flourishing villages once existed, but which now, in consequence of the high assessment, have been deserted to the ravages of the elephants.
>
> The villages on the table-land on the summits of the hills have been held from time immemorial by a peculiar race of men, who smelt the iron found in the hills, and cultivate their fields in peace, where the elephants do not ascend.
>
> While carrying on my trigonometrical observations along the Cavery, I have had frequent occasion to remark how incorrect the topography of the hills of Coimbatore is, as represented in the 61st sheet of the Atlas [pl. 23]. These hills, ... instead of being, as represented, a succession of low ranges, are a highly elevated tract of enormous mountains with table-lands little inferior to the Neilgherries, and, like them, should have been shaded up in strong relief.
>
> They are in many places very unhealthy, and are infested with elephants and tigers, from which cause the survey was probably neglected which was made as far back as the year 1809, under the then Collector of the district [II, 148, 214][6].

As already pointed out, the surveyors of 1800 to 1812 were not trained in the survey of hills, which were regarded as unprofitable and of no interest for revenue purposes [II, 145–6]. Also, as Bedford and Blacker before him pointed out, the representation of hills was bound to suffer when engravers worked from reduced maps, without knowledge of the real nature of the country [III, 297–8].

At the end of 1838 Campbell reported completion of the field survey;

> The survey was commenced in...March 1835, and...[the party] remained in the field without intermission until October 1837, when it went into quarters for three months. The whole extent...including a small portion of South Arcot is about 7,500 square miles, of which about 2,500 are a wild and mountainous country covered with jungle and infested by...elephants. ...
>
> The Baramahl lays...in an elevated tract of 2,000 feet above the sea, having in its northern portions, which are the highest, a cool and salubrious climate. ... The Salem...District...to the

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[1] Krishnagiri, 7–3–36; MBIO. 100 (1).
[2] MBIO. M 100, 6–9–37.
[3] the NE. monsoon of Oct.–Dec.
[4] about 35 miles s. of Bangalore.
[5] under Haidar Ali & Tipu, 1761–99.
[6] DDn. 387 (161), 12–9–38.

> south...is not more than 1,000 feet above the sea, and the climate is hot, damp, and generally insalubrious. ... The rocks are trappean, and minerals, particularly iron, magnesia, and corundum, are in great abundance. A geological map of the district and a set of illustrative specimens are preparing. ... The fair plan on the scale of 4 miles to an inch is on hand[1].

The only acknowledgement Campbell received for his very interesting report was a note from Bontein to the effect that "the Surveyor General has not at present time to give the necessary attention to this subject, but will refer to it when he is at leisure"[2]. Combining the administrative functions of Surveyor General with the exacting work of the Trigonometrical Survey, Everest was at this time engaged in the enthralling task of testing his astronomical circles at Kaliāna [133–4, 381].

Campbell spent the next nine months on his maps, and had then to wait for

> names of villages from the Collector. ... I...go through the whole of the names myself to correct the spelling of them, to which the native Tamul names form no guide, and I thereby hope to avoid the incorrectness...which I see in some of the published sheets of the Atlas, in which spelling is sometime so preposterous as to be totally unlike the real ones.
>
> The sub-assistants, when not immediately employed on the fair plan, have been...finishing the drawing, and entering the names on the plane-table draughts — in preparing the statistical papers... — and in carrying on their studies in mathematics and astronomy. ... I have also employed them...in studying mineralogy and geology [121, 259]. ...
>
> My own time has been principally taken up in the collection of materials for the geological map of the district. ... Besides examining the geology of...700 square miles, I...found it necessary to...chemically examine many minerals totally unknown before, or quite misnamed.

He enlarged on his scheme for a geological survey and map, and asked for the Surveyor General's approval. Again Bontein replied that the Surveyor General hoped to have time to attend to the matter later, perhaps in March 1840 [99–100][3]. Being thus left to his own devices, Campbell took the field on 1st January 1840,

> Mr. Howard having been detached to complete the survey of...Congoondy[4]—Mr. McMahon and Mr. Allan to make a fresh survey of the tableland on the Kholly Mally and Shervaroy Mally—and Mr. Boyne of the tableland of the Culry Mally[5].
>
> I have considered it necessary to make a fresh survey...on account of the former being on the scale of 1 inch to a mile and not sufficient to shew the...arable land, which lays in strips of about a quarter of a mile in width between the ridges of granite. ... This soil generally...well adapted for the cultivation of coffee. It is very scarce in the plains of the Salem District, and these hills are...the only part on which coffee is, or can be, raised to any extent. ...
>
> The cultivation of coffee in this district may be considerably increased, and [I] am preparing a report to the Madras Government of the subject, to accompany which I have directed the fresh survey to be made on the scale of 2 inches to a mile. ...
>
> The sub-assistants have been employed...in finishing...their plane-table draughts...and... statistical papers. ... The field work will probably be completed about the month of May, and the survey will then return into quarters at Royacottah. To complete the survey we shall have to finish the drawing...and the writing of the names, ... to finish the statistical accounts, and to make a copy...for...the Chief Engineer's office at Madras, and...a copy...for the Collector This work will probably occupy the rest of the current year[6].

In his final narrative Campbell points out that

> the whole of the topography of this extensive district was completed in nearly 3 years, notwithstanding I was absent in Goomsoor for 16 months, during which time Mr. MacMahon was taken away...to conduct the necessary triangulation. Mr. Howard was also employed in Goomsoor for 18 months. Mr. Boyne had been sick for nearly 12 months, and my two youngest sub-assistants were for some time...inexperienced in hill...sketching, and...never able to do more than half the work of the other sub-assistants. ...
>
> Part of the field work was gone through in a hurried manner, ... particularly...in the tablelands on the summits of our mountains, when the...fogs and frequent rains prevented the sub-assistants doing their work quickly, and, although generally correct, yet the scale was too small to admit of the work being done sufficiently neat and exact, ... whence the necessity of the revision of some portion during the present year, ... completed by Mr. MacMahon[7].

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[1] DDn. 410 (54–61), 14–12–38. [2] ib. 16–2–39. [3] from Campbell, 1–9–39; reply from Bontein, 29–11–39; DDn. 387 (175). [4] resurvey of Kongoondy, 1841–2, MRO. 262, 3 sheets. [5] MRIO. 135 (12–21). [6] Bāramahāl & Salem, MRO. 285, 288; DDn. 387 (191), 1–3–40. [7] original field sections, 4-inch, 2-inch, & 1-inch to a mile; MRIO. 133 (17 *et seq.*); 136 (47–52); ¼-inch, 136 (47); 147 (21); 8-m. to inch; 148 (17–20); Memoirs, MRIO. M 100; *Bo Geo Soc.* III (198).

After submitting the reports and maps in September 1841, many of the latter being beautifully drawn, Campbell kept his party busy on extra-departmental work for two and a half more years, when the Surveyor General at last arranged for his return to military duty [259][1]. Orders for the break up of the party and dispersal of the assistants were issued in April 1844. Records of the survey were finally completed by MacMahon and reached Calcutta before the end of the year[2].

GANJAM

After many changes and casualties Snell had brought the Northern Circārs survey northwards from the Kistna to enter Ganjam by the end of 1828. In eight seasons he had brought his party triangulation some 300 miles from Lambton's triangles in the neighbourhood of Guntūr, the survey being largely confined to the coastal strip [III, 99-101, 104]. By 1832 the survey of Ganjam had so far advanced that his military assistant, Thorold Hill, was detached to start triangulation in Nellore District and Snell joined him with the remainder of the party early in 1833[3] [255, 361].

Except for the coastal plain Ganjam had been hardly explored. The interior was wild, hilly, and most unhealthy, and the tribesmen, some addicted to human sacrifices, were giving a great deal of trouble. To pacify the country it was occupied by a military force, and shortly after Snell's departure, the Commissioner, George Russell, asked that the survey might be resumed.

> The survey conducted by Captain Snell was confined...to the more open part, ... the state of the country not then admitting of his assistants being sent into the difficult...hill tracts. As the uncertainty...respecting roads and distances has been the cause of much unnecessary fatigue and many failures in the operations of the troops, I...recommend that the survey may be resumed...as soon as the rains are over, ... to commence...in Purlah Kimedy. A correct map showing all the different passes in the range which separates the zemindary from the Vizagapatam District would give a complete command over that tract[4].

Hill was accordingly sent up in December 1833 to survey the Kimedi *zamīndari* "during the presence of the troops". Being appointed to succeed Ward in charge of the Trichinopoly Survey [250], he left Kimedi in October 1834, but on disturbances again breaking out he was recalled a year later for "the survey of the districts of Polkondah, Kemidy, Goomsur, and generally such parts of the Ganjam and Vizagapatam districts as have not yet been surveyed"[5].

He wrote at once to Calcutta for Snell's maps and triangles, at the same time informing the Surveyor General, who replied that such a call for documents

> from the Surveyor General's office excepting through the Surveyor General is...at variance with the orders both of the Supreme Government and the Hon'ble the Court of Directors. In consideration of the urgency of the present case, however, I am not disposed to lay much stress upon this departure. ... Lest Mr. De Penning should demur, ... which I think is... unlikely, I have written him...authorizing despatch of the surveys you have called for[6].

Hill was later joined by Howard from the Salem survey, and by Macpherson and Barnett from Nellore. He also had the assistance of Campbell who had rejoined his battalion from Salem [255, 361]. He records that

> until the resumption of the Goomsur Zemindari by Government [in 1836] no portion of the hilly country...was under the immediate control of the civil authorities, but was distributed among the zemindaries. ... Goomsur and Purla Kimmedy...I was enabled to survey during the campaign of 1834. ... On my arrival...in January 1836, ... from the unsettled state of the country and the want of an adequate establishment, I found it impracticable to do more than complete a series of route surveys [and]...the...hills north of Kolada. ...
>
> This season [1836-7], having had a large establishment placed under my control, the country has been fully explored. The roads hastily sketched last year have been resurveyed. ... On the force taking the field in November...Lieut. Macpherson, ... after triangulating across

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[1] GO. GG. in C. 22-3-44. [2] Mil Dept. 19-4-44; DDn. 471 (89-92), DSG.'s report, 23-1-45. [3] Maps MRIO. 138 (48), 146 (16-22). [4] from Russell, 28-9-33; DDn. 282 (412-3). [5] MRC. 22-12-35; DDn. 341 (7). [6] from Hill, 19-1-36, reply from SG. 29-2-36.

...to the frontier, was sent to explore and report on the road through the Chokapad country to Boad, which is more direct towards Nagpoor than the one usually traversed[1]. ...

Lieut Campbell proceeded into the hills to the west, and was employed in...Bodamah and the Deoghar valley till the cessation of hostilities enabled the Commissioner to send a party through...the Khond country to Sohnpoor, and thence southerly from the Mahanuddy to... Purla Kimedy, which Lieut. Campbell accompanied. ...

The party of sub-assistant surveyors from Nellore did not arrive till the later end of January and were, therefore, too late to be employed in advance of the Ghauts. ... I employed myself in the survey...from Durga Prasad to Patlinga...and then from Bybully to the Corada Zemindary...and the hills to the s.w. of Soorada. The Beeracot Motah and the country below the ghauts west of Kodunda was surveyed during...March by Sub-Assistant Barnett.

The road from D—to S— and thence to K—was surveyed by me last year in a hasty manner while accompanying a party of troops, and generally by night, but from bearings I then got by day at the halting places, and what I have since seen, I have every reason to suppose is not far from the truth[2].

The height of one of the principal hills in the Khond Maliahs above the sea, as determined by the boiling point of water, was about 4,200 ft., but as the thermometer used was a small one this can only be taken as an approximation. ... By trigonometrical measurement I find the height of Seetamoonda Hill, one of the highest peaks above Bybally, to be about 3,487 ft. above the level of the plain near Nowgam[3].

The Directors appreciated the value of the survey ;

The protracted campaigns in Goomsur, Palconda, and Purlakemedy which caused so great an expenditure of blood and treasure were mainly owing to our ignorance of the localities, and the want of practicable roads on which to move our troops to the required points[4].

About March 1837, on the close of military operations, Campbell and Macpherson returned to Salem and Nellore, whilst Hill kept Charles and John Summers [381–3] for...the survey of the unexplored parts between this district and the Nagpoor Territory as opportunities may offer. It is said a regiment will march through Goomsur to Nagpore via Boad etc. next season[5], in which case I hope to be allowed to penetrate through the heart of the Khond country...to the Nagpoor frontier. ...

The...survey having hitherto been carried on...by snatches, as the troops penetrated the country, I have not made any regular report. ... Now, however, that the country appears quiet, I am...completing some details in the low country[6].

Survey was interrupted by efforts to put down the horrible practice of human sacrifice, though warnings were issued against "any unnecessary display of force".

The zemendary...bordering on Parlakemidy and the Hill Mootahs of Ganjam may be explored under the protection of an armed escort of 50 men. I should not deem it prudent to visit the mootahs of Ganjam Hills...with so small a display of force, until the excitement occasioned by interference with the Meriah sacrifices be in some degree diminished[7].

In 1841 Hill applied for furlough ;

Since January 1834 I have been constantly employed in the hilly tracts and have suffered repeatedly from fever. ... Rheumatism succeeded the fever about two years ago, and although I was then advised to return home, I had hopes that my naturally good constitution would enable me to carry out the survey. ... In this, however, I have been disappointed, and am now so nearly crippled that I find it impossible to carry on. ... I have the surveys of my last route through the very heart of hills, from north to south, in an advanced state[8].

Early in 1842 he handed over at Madras to an officer who was not a surveyor[9], and never had been. As there were now no assistants left with the party, and this officer had other employment in Madras, it was impossible to take the field ; there was just one clerk left in charge of records and instruments[10]. After one more transfer, the survey was taken over by John Halpin under an order dated Fort St. George, 18th October 1842, and he restarted field work in 1843.

Waugh made the following review of the Ganjam surveys in 1860 ;

The...survey of...Ganjam was commenced...by the late Captain Snell, who was...well trained in the system of plane-tabling [II, 321]. The work, however, was not founded on

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[1] MRIO. 59 (23), Boad, by Macpherson. [2] Maps, MRO. 88, 89, 93 ; MRIO. 133 (33). sd. Hill, Ganjam, 10–10–37. [3] Memoir, MRIO. M 35. [4] CD to B. Rev. 21–11–38 (20). [5] cf. Van Heythuysen, 1822 [III, 410, 508]. [6] from Hill, 30–3–37 ; DDn. 387 (99). [7] from Hill, 5–8–39 ; MMC. 18–10–42 (71). [8] to SG., DDn. 403 (499–502), 10–10–41. Routes (by Hill ; MRIO. 73 (31–40) ; 72 (43–52) ; 133 (33) ; 149 (9–11) ; 135 (24) ; *IO Cat.* (275, 326) ; MRIO. 150 (12, 23–4). [9] John Carne Boulderson (1806 ?–1868/70), Mad. Inf. [10] DDn. 405 (48–9), 12–4–42.

> the Great Trigonometrical Survey, but on an independent triangulation and separate base. ... It was, therefore, of desultory character, and the precautions, ... especially in the marking of stations, were not rigidly attended to, which makes a union...beset with great difficulty. ... Still, as the work was founded on a triangulation, and Captain Snell was an able surveyor in details, his survey of Ganjam is very complete and valuable.
>
> He was succeeded by Captain Thorold Hill, a very talented officer, who was employed in the Goomsoor war, and under local orders, and...detached on explorations...as far as Nagpoore. These were desultory route surveys in which, ... triangulation being neglected, the results were next door to useless, and...no complete or accurate map could be expected.
>
> With great difficulty I incorporated these discordant materials in 1844, but the map thus produced can only be considered a rough preliminary reconnaissance. ... Captain Hill retired in 1841 on account of ill health occasioned by exposure[1] [250, 361].

Part of Hill's map of 1837, including part of Snell's survey of 1830–2, is reproduced as plate 15.

NELLORE, 1732–42

On 11th December 1832 Thorold Hill from the Ganjam Survey left Madras for Nellore, taking with him Chatalier and Charles Snell, junr. He spent the month

> instructing the two apprentices, laying down secondary points to facilitate the operations with the plane-table, and surveying with the plane-table ; about 40 square miles completed. ...
>
> This year having passed without any rain during the monsoon months [251 n.3], I have been enabled to take the field early. ... I have two apprentices here from the school at Madras ; they promise well, but will not be of any effectual service this season. This is a very fine country, and our having Colonel Lambton's points, etc., will render it a comparatively simple work[2].

Snell followed with the rest of the party during 1833, starting field work in earnest in December. About 1,400 square miles were surveyed during season 1833–4 and another 1,680 during 1834–5. Triangulation was based on Lambton's triangles and Garling's work of 1810 [II, 399]. Survey was on the one-inch scale, fair maps on the half inch, and triangulation charts on the quarter-inch scale[3].

On 30th June 1835 Snell handed over to Samuel Macpherson and withdrew from the survey. Macpherson and his assistants took part in the survey of Goomsur during 1836 and 1837 [253], and Nellore District, with part of North Arcot, was not completed till 1840, by which time 4,850 square miles had been surveyed at a cost of Rs. 39,330. Very neat detailed surveys of the roads with descriptive reports were a feature of the survey[4].

From March 1839 Macpherson took two years leave to New South Wales, leaving the party under Barnett's charge until it was taken over by Thomas Ryves in November 1840. With field work drawing to a close Ryves proposed to revise the work of the old Military Institution [III, 96], but this was not sanctioned. In September 1842 orders were issued for the party to be broken up and Ryves surrendered charge to Barnett at the end of February 1843, but it was not until 21st December that the final papers of the survey were submitted, "finished" writes the Surveyor General "with that degree of style and completeness of detail for which the Madras Surveyors are eminently distinguished"[5] [362, 383].

NIZĀM'S TERRITORIES

Garling had started the regular survey of the Nizām's Territories, or Hyderābād State, in the south-west, and work had been gradually extended to the north and east until, when Henry Morland took over charge in 1829, most of the country south of parallel 18° had been surveyed. Much of the country was most unhealthy, and, writes Montgomerie, in reporting the death of James Dardell [III, 436],

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[1] SG.'s report DDn. 491 (68–9), 25–7–44 ; and DDn. 6–10–60 ; MRIO. 133 (47). [2] DDn. 330 (17–8); 388 (3–4), 15–12–32. [3] Barnett ; Chas & John Summers ; C. Snell junr., Chatelier. ; me moir, DDn. 329 M 82 (119). [4] DDn. 396 (193), 22–9–40 ; *IO. Cat.* (363–371) ; GBO. Lib. Aa 46. [5] Maps of N. Arcot, Nellore, MRIO. 136 (4, 5) ; 147 (2–8) ; MRO. Map 247 ; DDn. 452 (70–3), 13–1–44.

> Not only have all the members...been attacked with severe jungle fevers, but numbers also of the guard and followers, ... so that surveying operations...are nearly at a stand. The Superintendent and some of the assistants[1] were obliged to return to Secunderabad for medical aid not long after taking the field. As the field operations...are now carried on at a considerable distance from Secunderabad, and as many of the tracts yet to be surveyed are of a most unhealthy nature, I...solicit that...an efficient Assistant Apothecary, with a proper supply of medicines, be attached from...the Hyderabad Subsidiary Force[2].

During 1831 the survey was transferred to the immediate control of the Surveyor General, as Hyderābād had for a long time dealt direct with the Supreme Government and was no longer any concern of Madras [248]. Morland took sick leave in February 1832, and Du Vernet assumed charge from Macpherson who had been posted as assistant after Dardell's death. During the next two seasons work progressed at the rate of between 3,000 and 4,000 square miles in the western *circārs*.

In January 1836 Du Vernet took leave to Europe, and Chamarett, the senior civil assistant, held charge till Morland rejoined in July. Being asked how long it would take to complete the survey, Morland replied that

> the work would be very greatly accelerated by the appointment of one or more additional officers as Assistant Surveyors, it being next to impossible for one officer to carry on the triangulation and at the same time exert strict and efficient superintendence over the large party of sub-assistants, scattered, as they are, over a very considerable tract [3].

No military assistant was available, and when Morland went on leave in October 1838, Chamarett again took charge. Thomas Ryves was appointed to charge in July 1840, but after Morland's return was transferred to Nellore [361–2].

The general sequence of the survey ran from Raichur in the south-west, the whole of the Tungabhadra-Kistna *doāb* being surveyed between 1816 and 1819. Survey then proceeded through the districts to the north of the Kistna, Pangul, Devarkonda, Nalgoonda, Hyderābād, and Khammammett Circārs being surveyed by 1824. Nilkonda and Gulbarga followed by 1825; Medak by 1828; Warangal and Kowlass by 1831; Bīdar, Kalyani, Naldrug, and Osmanābād, by 1833; Eilgundel, 1834; Bhir, to the west, in 1835[4].

In 1837 the party was split between Nander on the Godavari and Khammammett to the far east, to complete practically the whole area south of parallel 18° 30′ [III, pl. 18]. Chamarett now estimated that quite 15 years work remained to the north-west, "considering the unhealthiness of the eastern portion, and Colonel Lambton not having triangulated it"[5].

There had been so much sickness during the rains of 1837 that Morland found it was useless to take the field with only two assistants fit for work;

> Mr. Britain...is at this moment in a very dangerous state, and Messrs. Ignatio and Turnbull are, I fear, very seriously indisposed. The arrears of work, even supposing the whole party to be available, ... will occupy at least three months. When all is brought up, I propose...to employ the party in laying down the detail in the neighbourhood of this station [Jālna] so far as the weather will permit of, until the conclusion of the monsoon when the survey of the Nandeir Circar will be resumed[6].

At the end of 1840 he reported the work done since he first took charge;

> From August 1829 to February 1832...Circars Maiduck and Worungul, with portions of Cummummett, Beeder, and Kowlass, ... an area of 10,370 square miles, were surveyed, and the expenses...were Rs. 50,170–11–7. Severe and repeated attacks of jungle fever compelled me to resign...and proceed to England...in June 1832. Lieut. Macpherson...assumed temporary charge, and completed the unfinished portion of the Beeder and Kowlass Circars, ... 2,550 square miles.
>
> In January 1833 Lieut. Du Vernet was directed to assume charge...and continued...until January 1836. ... The area surveyed by this officer was 9,526 square miles, the expenses... Rs. 64,940–5–9. Mr. Chammarett held temporary charge...until I was reappointed...in July 1836. ... He had surveyed the small Circar of Darroor, ... 3,098 square miles[7].

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[1] Chamarett; Long; Britain; Wm. Ignatio; Wm. Turnbull; Parlby. [2] DDn. 328 (27–9), 12–5–31. [3] Bangalore, DDn. 353 (38–41), 5–8–37. [4] MRIO. 67 (32); 68 (15 *et seq.*); 69 (11–22); 70 (1–107) Memoir, Bhir Circar, DDn. 327, M 151. [5] Index Map, MRIO. 67 (31), submitted by Chamarett, Jālna 7–8–37; DDn. 353 (41–2). [6] DDn. 326 (335–6), 16–12–37. [7] progress index, MRIO. 66 (3); area 1829 to 1840 was 37, 434 sq. m. costing Rs. 2,27,586 [249].

> I continued in charge...until October 1838. While on survey during the monsoon, ... a severe inflammation and affection of the right eye[1] compelled me to proceed to Secunderabad, and subsequently to Madras for medical assistance. ... 28th September [1840]...I rejoined... at Jaulnah. ... During my absence Mr. Chammarett continued the survey of the Nandair Circar, and finished about 3,900 square miles. ... At present the highest parallel...to which the survey has reached is 19° 30′, about 24 miles north of the town of Nirmul, on the high road from Hyderabad to Nagpore[2].

He suggested that it would take at least eight years to complete the survey, including the districts of Berār[3]. Proposals to speed up the work by sending up the two parties from Salem and Nellore were dropped after a long correspondence, and after Morland had visited Calcutta [248].

Work was now proceeding more slowly to the west, beyond Lambton's triangles, and the party had to carry out its own principal triangulation. By 1843 they had completed Nānder and Pāthri *circārs* north of the Godāvari, and part of Aurangābād District round Jālna.

PROFESSIONAL DETAILS

In both the Salem and Nellore surveys it was the practice to carry on field survey continuously through the year, leaving no time for tidying up the field sections after the season's work ; they were just stripped from the planetable [250–1]. The writing up of names and preparation of fair maps were left to the close of the survey, and took at least twelve months—a most unsatisfactory arrangement.

In the Hyderābād survey a few months of the rains were spent in recess every year. Montgomerie had criticised the maps that Morland sent in during 1830 ;

> Many inaccuracies are to be discovered in the reduced map on the most cursory inspection. The hilly and high ground is very imperfectly delineated—the...latter feature, indeed, ... nearly wholly omitted—and the whole is too much obliterated by trees and dark jungle.
>
> The points trigonometrically determined by you last season were not...nearly numerous enough to ensure perfect accuracy in taking up the topographical detail, and such a triangulation should, if possible, have been conducted so that three or more points...should have fallen within the limits of each section. ...
>
> By the...original...instructions to Captain Garling [III, 114–5, 209]...a diary...was directed to be kept, to be transmitted...with the other records. ... This practice appears not to have been attended to of late years. ... It may be observed in future, and which you will require from all those under your orders, in as concise a form as possible.
>
> In preparing progress sketches in future, be pleased to insert the high roads passing through the tracts surveyed[4].

In December 1831 Morland submitted the maps of Warangal Circār about six months after completion of the field survey [III, 119–20]. The documents included—

> Geographical Memoir of the Warangal Circar. Register of villages and plan of triangles. ... Measured high roads. Map of the Warangal Circar on the scale of 1 mile to an inch. Reduction...on scale of 4 miles to an inch. ...
>
> Triangles 43 to 62 were executed by the late Lieut. Dardel after I had been compelled to return to Secunderabad by severe illness. The distances marked by dotted lines must have been determined by that officer, as he himself laid down the points...on the plane-table of the sub-assistant surveyor, ... but I have not been able to discover amongst his papers the data from whence they were derived, and fear they were inadvertently mixed up with other papers, which his servant informs me he destroyed the day before his death[5].

The Surveyor General questioned the data shewn on the triangulation chart ;

> I do not understand how you have filled up from the 43rd to the 62nd triangles, inclusive, to the nearest second, without the necessary data, ... missing at the death of the late Lieut. Dardel. ... Oblige me by a detailed...explanation, ... for I know of none other but either computing the angles from the sides, or going over the work again[6].

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[1] *herpes opthalmica* ? [2] map, 4 m. to inch, MRIO. 67 (34–7) ; 1-inch, ib. Misc. 8–O–41. [3] DDn. 343 (377), Jālna, 2–11–40 ; districts "assigned" to British by Nizām, Amraoti, Buldāna, Akola, Yeotmal [II, 133 n.1]. [4] DDn. 328 (24–5), 29–10–30. [5] DDn. 272 (98), 20–12–31. [6] DDn. 267 (99–101), 16–1–32.

In forwarding these maps and papers to Government Everest repeated this criticism, and remembering the confusion after Lambton's death [III, 464–9] pointed out that

> public documents of consequence being mixed up and confounded with private papers, and so liable to be destroyed or lost by casualties, shows strongly how necessary it is to keep the office establishment entirely distinct from the personal affairs of the individual. ... The most effectual way of obviating this is to supply an office tent for conducting business in camp[1].

When in December 1841 Everest recommended that the Hyderābād survey should be continued [249–50], he expressed himself fully satisfied with the use of the planetable, provided that it was sufficiently controlled by triangulated points and constantly inspected by a competent officer [II, 216 ; III, 208].

> I have always supposed it to be the object...to fill up the...triangles of this vast skeleton... by means of a planetable, small theodolites, and other ordinary means. That is the plan pursued on the continent of Europe. ... It is that...alluded to in my Lord William Bentinck's able minute [III, 195–6 ; IV, 19, 262], and, when the limiting points...are sufficiently...close to each other, unquestionably delineates the features of a country adequately for...the atlas sheets.
>
> It has the recommendation of being cheaper than that pursued by Colonel Colby in... Ireland, ... more expeditious, and needing little or no computation, the indoor work being chiefly that of the draftsman on whose expertness...the value of the performance mainly depends.
>
> But though...the use of the planetable is...highly desirable, yet, ... had there been no triangulation to precede it and place limits to the accumulation of errors, I should on no account be its advocate, because...of itself this simple instrument cannot be employed in any area of any extent without generating serious discrepancies. Even the hygrometric nature of the paper must be an inseparable obstacle [III, 109, 195].

For the eastern districts a net of secondary triangles had been thrown

> over the whole of the Kummummett Sirkar as far east as the Godavery [III, pl. 18]. This secondary triangulation seems to have been very creditably performed, and though the method does not seem to me precisely that calculated to give the greatest degree of accuracy, because of the smallness of the base[2], ... yet it is sufficiently so for the purposes of topography.
>
> In spite of the advantages of the planetable...its operations are merely linear ; ... no numerical values either of distances or angles are registered. It is, in fact, a pencil sketch, ... and the sheet on which the drawing is traced in the field contains the sole record. ... The means of checking results...are all but wanting. ... We must depend entirely on the confidence to be reposed in the party by whom it is effected. ...
>
> Hence...the control...of the Surveyor General or his Deputy...needs to be maintained... in the fullest vigour. ... No officers unless recommended by him should be appointed to the charge of such operations. ... An occasional inspection, not only of the records, but of the actual working, should take place. ... Not only the officer in charge, but all...subordinate to him, should be persons of whose character and qualifications the head of the department is intimately cognizant.
>
> The Superintendent of the Trigonometrical Survey of Ireland makes two tours of inspection annually to visit all his parties in the field, and thereby only exerts what he deems a sufficient supervision that is, perhaps, not to be accomplished in India, because the circumstances...such as want of roads and inns are so totally different.
>
> We must either conclude that such periodical visits of inspection are necessary for the maintenance of...accuracy, or that they are a work of supererogation. ... In the former light, they point to the expediency of concentrating all operations...as much as possible, and making such provision as will enable the Surveyor General, either personally or by means of qualified deputies, to undertake similar tours without fear of his office business falling into arrears[3].

The practice of leaving all triangulation to the officer in charge of a party prevented his making that constant examination of his planetablers' work in the field that is now regarded as essential.

There have been many survey officers who have found that the regular work of the department along methodical lines was not sufficient to occupy all their time ; whose vigorous and inventive genius called them to break away from established methods, and who not only tended to neglect their humdrum routine duties, but worried their senior officers with bright suggestions for new methods that may have been proved impracticable a generation or two before. None was more fertile in imagination, more persistent, more self-confident, and more of a trial to his seniors, than John Campbell, who, when officially employed on straightforward topographical survey, spent a great part of his time on geology and astronomy, and plans for revenue and astronomical surveys, and pestered the Surveyor General with his proposals. Everest rebuked his demand for astronomical instruments ;

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[1] DDn. 283 (11–3), 16–1–32. [2] Punchpandal-Chitapully, 8,292 ft. [3] to Mil. Dept. 13–12–41 ; DDn. 402 (197–207).

> Captain Campbell is conducting a topographical survey, and can have no claim to instruments which are not allowed on all like occasions. The system which Captain Campbell proposes to employ...is precisely the very one which...the Court of Directors have decided to be unsuitable. ... It would be rather late in the day now to set about revising a system which has by general consent long since been exploded [III, 185–6 ; IV, 261]. ...
>
> An officer conducting a topographical survey ought to have sufficient work to employ his whole time. ... Astronomical or other pursuits...can only tend to distract him from his more important duties, and create confusion[1]. ...
>
> I have little time for discussion, ... particularly for those questions which have over and over again been sifted, examined, and settled [t-page]. The principles of accurate topography are sufficiently well understood and laid down, and, as it is like searching for the philosopher's stone to seek to devise a new system, the best way for all parties to do their work is to abide by the old and universally approved methods[2].

With supreme confidence Campbell offered to re-observe Lambton's southern triangles of the Great Arc with instruments made up locally ;

> Being perfectly conversant with the labours and investigations of the French geodesists, I do not anticipate any difficulty...which I shall not be prepared to meet, and, although I do not anticipate any better result...than Colonel Lambton was able to produce, ... I shall be able at least to produce a gratifying and useful proof of Colonel Lambton's correctness. ...
>
> I have put to the test the...native workmen under my tuition by constructing by their hands philosophical instruments equal in appearance, and superior in...power, to the best which have ever been constructed in Europe, for less than 1/10th of the cost in London[3].

He offered to make a four-inch revenue survey of Salem District shewing,

> each field of dry cultivation. ... 4 sub-assistant surveyors could complete in about 4 years...the Salem District, the cultivated portion of which is about 3,000 square miles in extent. By employing...6 intelligent natives under each sub-assistant surveyor, the whole...might be finished in 12 months at an expense of...about 1/100th part of the revenue of the district[4].

Two years later he reported that he had been making experiments in surveying "by the method of offsets from rectangular co-ordinate lines", and that the Madras Government proposed to take up the revenue survey of Tinnevelly on these lines.

He reported that though there was a triangle of the Salem survey that remained for revision, he had not been able to spare MacMahon to do the work because he had been engaged "upon a set of nineteen hundred repetitions of an angle" with a small repeating theodolite, by which experiments he had proved that the theodolite was not capable of high accuracy by this process[5].

Waugh could stand this no longer, and pointed out to Government that he had received no progress reports on the Salem survey for 18 months, by which

> the publication of sheet No. 79 of the...Atlas has been unnecessarily delayed. ... Captain Campbell appears to have employed himself and establishments...in making experiments... altogether extra-official and unauthorized. ... They tend to revive exploded theories which have long ago been set at rest. ... With regard to the repeating instrument, ... any practical man...can satisfy himself of its capabilities by few hours trial[6].

A week later he reported yet another long letter from Campbell, this time putting up proposals for "the manufacture of iron from the country ores" [121]. Waugh showed that there was no need whatever for the revision of the particular triangle suggested by Campbell, and orders were at last issued for the disbandment of the Salem survey, and Campbell's reversion to military duty[7]. It is indeed extraordinary that a field party should have been allowed to linger on for more than two years after the completion of its official programme. It was obviously impossible for the Surveyor General to control his large department without an efficient Deputy. There was no Deputy Surveyor General between Bedford's departure in January 1843 and Wroughton's appointment in March 1844 [323, 326].

[1] DDn. 410 (122–5), 1–7–40.
[2] ib. (152–6), 4–9–40.
[3] DDn. 387 (361), 26–2–42.
[4] ib. (369), 26–2–42.
[5] ib. (423), 14–2–44.
[6] DDn. 452 (104–7), 1–3–44.
[7] ib. (114–5), 1–4–44.

CHINA

During the war with China of 1840 to 1842, which resulted in the British occupation of Hongkong, two companies of Madras Sappers and Miners formed a notable part of the small Indian contingent. The exhausting campaigns in the neighbourhood of Canton and Ningpo were brought to an end by the treaty of Nanking, signed on 7th August 1842[1].

The companies were commanded by Thomas Pears, and had among their officers Lieutenants John Rundall and James Johnston. Amongst the many maps of China preserved at Dehra Dūn[2] are a

Reconnaissance sketch of the attack on the defences at Amoy on the 26th August 1841 by a combined Naval and Military force under Lt. General Sir Hugh Gough and Rear Admiral Sir William Parker, by Lts. Rundall and Johnston, Madras Engineers. Scale 1 inch to 400 yards. Map. sd. by Captn. Thos. Pears, Commanding Engineer, Eastern Expedition[3]. ...

Field sketch of the attack on the Chinese positions on the Singpo at Chingai, Oct. 1841, ... by Lt. Rundall[4]. ...

Military sketch of the country about Jinghae showing the attack on the Chinese defences... on the 1st Oct. 1841. ... Enlarged from an original survey of Captn. Anstruther by the Madras Engineering Department, Eastern Expedition. Scale 8 inches to 1 mile[5].

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[1] Sandes, I (279–82). [2] See also *IO Cat.* (507–9). [3] MRIO. 87 (1). [4] ib. (16). [5] ib. (38).

CHAPTER XVI

BENGAL PRESIDENCY : GEOGRAPHICAL & OTHER SURVEYS

General Policy — North-East Frontier — Lower Bengal — Chota Nāgpur — Upper Provinces — Central Provinces — Rājputāna — TRANSFRONTIER EXPLORATION ; Alexander Burnes 1831–3 — John Wood, 1836–8 — Afghān Wars, 1838–42.

UNDER Everest's administration the survey effort in Bengal was concentrated on the extension of the Great Trigonometrical Survey and the development of land revenue surveys ; geographical and topographical surveys were only authorized for occasional limited purposes. In order "that a system of perfect uniformity should prevail throughout their survey department", the Directors abolished the branch offices at Madras and Bombay [248], and "expressly prohibited all surveys in which measured distances by perambulator or other means are checked by observations for latitude and longitude"[1].

Everest suggested that his own triangulators should fill in the main features between the meridional chains of triangles by means of secondary points and plane-tabling on which the old surveys might be adjusted [13][2].

> In the flat lands of the Doab and Ganges, I have calculated on making all the use possible for information previously obtained by route and perambulator surveys. ...
>
> If two series start at the distance of 60 miles from each other, there will in hilly countries be none but occasional breaks for, to the distance of 30 miles on each side, the eye will almost always be able to reach an intermediate point which then becomes common to the two series, and so the network is complete, except here and there. ... But in flat countries the distance is limited to 17 or 18 miles instead of 30, and the easternmost station of one meridian is 42 or 43 miles distant from the westernmost of its neighbouring series, so that to fill up the intervening space two new artificial elevations would be necessary. ...
>
> My opinions...are given full length in a memoir which I gave to the Court of Directors when I was in England[3].

Government decided against such subsidiary survey [14], but encouraged the running of special minor series, branching out from the principal triangles, to fix the positions of important cities, or survey the course of important rivers, that would not otherwise have been accurately laid down [24, 79–81].

The Directors emphasized that their first desire was the early extension of the quarter-inch Atlas of India over the whole country, and it was to this end that they gave priority to the Great Trigonometrical Survey [3, 9, 22, 299, 303]. Priority was to be given to the triangulation of Bihār and Bengal, for the

> completion of the geography of those Provinces, the topography of which has been so accurately delineated by the late Major Rennell. ... We therefore wish the Surveyor General to depute with the least practicable delay a party for the express purpose of fixing the requisite number of points in the area embraced by Major Rennell's surveys [I: 226].
>
> Our Marine surveyor[4] (who, we suppose, is at present on the coast of Chittagong) may perhaps be usefully employed in surveying the coast line of the Sunderbunds. ...
>
> As the expenses of the survey department are of large amount, and must continue to be until the completion of the Indian Atlas, we trust that you will use every exertion to bring it to an end with as much expedition as is consistent with accuracy[5].

Though Rennell's 5-mile maps were woefully deficient in detail, the Directors were probably wise to postpone the resurvey of Bengal where many areas were coming under revenue survey [I : 226 ; III, 274 ; IV, 20, 250] whilst other parts of India had scarcely been surveyed.

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[1] DDn. 267 (142–3), SG. to Wroughton, 11–9–32 ; DDn. 286 (253), to Mil. Dept. 21–6–32 & 23–6–36.
[2] much as Lambton had done at first [II, 242].
[3] to Mil. Dept. 10–1–31 ; DDn. 265 (303–8).
[4] Richd. Lloyd, succ. Daniel Ross, elsewhere "Marine Surveyor General" [113–4].
[5] CD to B., Mil., 16–1–33 (8–13).

After the close of the Lower Brahmaputra survey in 1834 [266–7], no topographical surveys of the Bengal Presidency were included in the Surveyor General's periodical report[1], and, though the Government of India looked for a wide extension of geographical survey on the completion of the Great Arc[2], the personnel then released was all required for new meridional chains of triangles across the lower Ganges. Instead of the one party which the Directors fondly hoped would be sufficient to fix control for Rennell's surveys, it took from four to six parties no less than twelve years to complete the triangulation grid between Delhi and Calcutta, and that by no means covered all Rennell's work.

Though the Directors thought that it would be a simple matter to fit old surveys to the new triangulation, Everest thought that many would have to be considerably twisted "to fit them...in their proper places". He agree, however, that the work of the revenue surveyors should be valuable material [20].

On the general principles of conducting surveys, two important papers were written just before Everest's return to India. A minute by Lord William Bentinck, dated 3rd September 1829, laid down the broad principles of planetable and traverse surveys based on a framework of principal and minor triangles, with the survey staff organized by regions [III, 195–6 ; IV, 19].

The second was a pamphlet on revenue surveys published by James Herbert entitled "An account of the Present System of Surveys"[3] [205 n.6, 211]. This was professionally sound, but soon rendered out of date by the increasing demands, first for greater speed in delivering the results required for assessment of revenue, and secondly for more exact measurement field by field.

Probably more interesting than either would be the paper on revenue surveys which Everest himself submitted to the Directors whilst he was in England in 1829 [III, 446 ; IV, 261]. Though he refers to it several times no copy has been found[4].

NORTH-EAST FRONTIER

There was much desultory survey and exploration along the north-eastern frontiers and into Upper Burma, largely directed by Robert Pemberton and Francis Jenkins, who were for some time the most active political officers in these regions.

In 1830 James Jackson [III, 462–3] was directed to make an intelligence report on Arakan, with Pemberton as assistant. As Jackson was unfit, Jenkins was appointed in his place and instructed to

> ascertain the position most eligible...as the headquarters of the province of Aracan with respect to healthiness, facility of communication with Calcutta by sea and with Chittagong by land ; facility of movement for land service, whether within the Province or...beyond the mountains ; ... [and affording] defensive position by one regiment. ... Finally you will proceed by land to Chittagong, inspecting minutely the line of road. ... You should then proceed by way of Sylhet and Cachar into Munnipore, and from thence into Upper Assam [III, 494][5].

Jenkins and Pemberton concluded this lengthy tour in January 1832 by passing through the country of the Angāmi Nagās, the first recorded visit ever made to these remote people. Their route led from Manipur to Jorhāt over a range that rose to 6,419 feet above the sea, and their party included "700 soldiers and 800 coolies"[6].

Pemberton's map covered "the Province of Aracan with adjoining districts of Chittagong & Ava"[7], and he asked for further orders, having completed "the several reports upon Kachar, Muneepoor, Assam, and the Cossyah Mountains, on which Captain Jenkins and myself were jointly engaged", and being "now employed on the calculations necessary for the construction of a map of the newly explored route ...from Muneepoor to Assam"[1].

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[1] BM Addl MS. 14380 (2–3), Annual Report for 1834–5. [2] DDn. 343 (369–76), 30–12–40. [3] BRC. 28–6–31. [4] CM. 28–10–29 records letter from Everest of 2nd inst. with Memoir on "leading features of the Irish survey, and a comparison...with the system pursued in India.", *v.* BM. Addl. MS. 14380 (18). [5] HMS. 677 (485–507), 11–2–31. [6] Butler (102); Maps MRIO. 37 (1–5). [7] ib. Misc. 11–0–31.

His services were offered to the Surveyor General for employment in trigonometrical or revenue surveys [270][2], but such humdrum work was not at all to Pemberton's liking, and he had no difficulty in retaining his political association with the frontier. He made other routes and surveys, and compiled valuable maps[3]. He countersigned several routes surveyed by George Gordon [III, 454][4].

Though Thomas Fisher [III, 447-8] could no longer spare time from his political duties for active survey, he still kept up a warm interest in the maps of the North-East Frontier, which he reviewed in a *Memoir of Sylhet, Kachar, and the Adjacent Districts*, published by the Bengal Asiatic Society in 1840[5].

In 1837 Pemberton was appointed to lead a political mission to Bhutān, in an effort to check the constant raids across the Assam border. He was accompanied by Dr. Griffith, the celebrated botanist, and by an escort of 25 Assam Police commanded by Ensign Muirson Blake, who made a useful surveyor. Pemberton's full account of the mission was published in 1838 ; other accounts have been published by Eden and Markham[6].

Avoiding the routes traversed by Bogle and Turner in 1774 and 1783 [I : 73-5], the mission entered Bhutān by Dewāngiri to the east, marching up through Kāmrup. It traversed Bhutān by a circuitous route of 26 marching days, and reached Punākha, the capital, on 1st April 1838. After a short stay they marched out direct to the Buxa Duār, and reached Goālpara in May.

Pemberton's report gives a full account of the rivers, roads, and geology. Griffith described the vegetation, boundaries, and social conditions. Blake's map was on the scale of 2000 yards to an inch, and covered nine sheets, each giving a route table[7]. With his report Pemberton submitted

> four maps, one of the Bootan Dooars in Assam, a second for those of Bengal, a third showing the country traversed by the mission, ... and a fourth, a general map containing all the geographical information collected [265 n.10].
>
> There is a table of distances covering 40 marches from Dewangiri, by Punakha, to Rungamutty. ... A table of latitudes and longitudes. The observations for latitude were all made with a Troughton's reflecting circle on a balanced stand, and have been deduced from meridional altitudes of the sun and stars. The longitudes have been calculated from the route survey made by Lt. Blake, and the value of the degrees has been computed from Colonel Lambton's Table, with a [compression] of 1/304 [II, 260-2].
>
> I took a very superior achromatic telescope with me...in the hopes of obtaining observations of the eclipses of Jupiter's Satellites, ... but was invariably disappointed from the clouded state of the atmosphere at the moment of the eclipse of the satellite[8].
>
> My chronometer is one by Barraud which I purchased from Mr. Gray [128] just before leaving Calcutta. Its rate is 1″ per diem, gaining, and I have deduced the longitude of [Dewangiri] from Gowhatty by it. It is an excellent timekeeper[9].

Pemberton's general map showed "the curious annular lake called Lake Yorbrogh Yumtso (or Palte)", that lies on the road to Lhāsa[10]. He made particular enquiries about the sources of the Brahmaputra, endeavouring to gain confirmation of Rennell's deduction that it came from the Tsangpo of Tibet, and Wilcox's shrewd calculation that the Dihang was the channel by which the two great rivers were united [I : 79 ; III, 56, 64] ;

> I fortunately met at Dewangiri and other places with persons who were either residents of Lassa, or had visited Teeshoo Loomboo, and were familiarly acquainted with the Tsanpo and Burhampooter, and they distinctly described its course as passing through the Arbor Hills, and terminating in the valley of Assam.
>
> These statements...have been since strengthened by the sight of a manuscript map forwarded some years ago to Captain Herbert...by Mr. B. Hodgson, the accomplished scholar and Resident of Nepaul, in which the same course is assigned to this river [III, 20]. ... I consider the

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[1] to Ch. Sec, 12-11-32 ; DDn. 281 (54-7) ; *Map of Manipur...& Burmese Frontier, 1837 ; JRGS.* XI, 1842 (xxxvi). [2] he had served with .Rohilkhand rev. svy. 1823-4 [III, 154]. [3] MRIO. 36 (6-11); 98 (15, 16), 154 (4). [4] ib. 36 (33, 47-9), 173 (27), 175 (24). [5] *JASB.* IX, 1840 (808-43). [6] Ashley Eden (15-46) ; Clements Markham (lxxxii). [7] MRIO. 91 (3-12), including ¼-inch reduction. [8] Pemberton (176-208). [9] *JASB.* VII (90-1) ; from Pemberton, 11-1-38. [10] *JRGS.*, XI, 1841 (lxx).

> evidence so satisfactory...that nothing short of ocular demonstration to the contrary would now shake my conviction of the justice of the opinion of our unrivalled Geographer, Major Rennel, "that the Tsanpo and Burhampooter are one and the same river under different names[1].

Pemberton and Griffith have both left vivid accounts of the difficulties of the march, Pemberton writing of the crossing of the "Domyla La";

> We started from a halting house on the morning of the 15th February at an elevation of 8,000 feet above the sea, and after ascending 1,000 ft. entered a snowy region where we found every tree heavily laden with icicles and snow. ... We toiled up this...weary ascent until 1 o'clock when we reached a ridge...11,245 feet above the sea, ... and...by zigzag paths...finally reached the north-west crest. ... This point was 12,480 feet, ... and we commenced the descent about 3 p.m., and here the cold became much more severe. ... We...then pushed on through a succession of ravines expecting every moment to arrive at the promised village. ...
>
> The increasing darkness and difficulty of the road rendered advance every minute more impracticable, and we were at last so completely involved in darkness that it was quite impracticable to advance further. ... We determined to retrace our steps to an open spot in the rear, rather more free of snow than any around us. We did not reach this halting place till past 8 o'clock, when we contrived to make an old tree contribute to our comfort by converting some of its branches into firewood and passed the night in the open air, surrounded by snow, at an elevation of 9,600 feet above the sea.
>
> Blake and myself and three or four servants were the only persons who reached this spot. Griffith had halted a little behind us, and the people of the camp were scattered over...about three miles. ... The village we did not reach until past 10 o'clock the following morning, and several of the Bhuteeahs with the baggage did not arrive until two days afterwards[2].

Griffith writes of the same episode;

> We started at the break of day, as we had been told that the march was a long and difficult one. ... In the evening I came on the coolies who had halted at a place evidently often used, ... and who positively refused to proceed a single step further. But as Captain Pemberton and Lieut. Blake had proceeded on I determined on following them. ... I found myself benighted on the borders of a wood into which I plunged in the hopes of meeting my companions, and—after proceeding about half an hour, slipping, sliding, and falling in all imaginable directions—and obtaining no answers to my repeated halloos—after having been plainly informed that I was a blockhead by a hurkarah, who as long as it was light professed to follow me to the death—I thought it best to attempt returning, and after considerable difficulty succeded in reaching the coolies at 8½ p.m., when I spread my bedding under a tree. ...
>
> I resumed the march early next morning, and overtook my companions about a mile beyond the furthest point I had reached, and...found that they had passed the night in great discomfort. ... Total distance of march 15 miles; greatest ascent 4,500 feet, descent 6,100[3].

Two years earlier Griffith had made a interesting journey over the Khāsi Hills, in search of tea [204], and during 1838-9 Thomas Sale ran a road survey across the hills from Gauhāti to Sylhet, passing through Nongkhlao [III, 64] and Mawflang, and by the Kalang rock and Nongkrem, site of the annual fair[4].

Information was coming in from travellers in Burma, encouraged by Henry Burney [III, 431], now Resident at Ava. Dr. Richardson made his first journey in 1831 from Ava to Kindat on the Upper Chindwin near the Manipur frontier[5]. Between December 1836 and June 1837 he marched from Moulmein, where he was surgeon to the Commissioner, to Mandalay, travelling through Karen country. Two years later, accompanied by William MacLeod, of Madras Infantry, he led a mission to Siam, travelling from Moulmein to Chengmai in Upper Siam, and then south to Bankok. He left Moulmein on 18th December 1838 and reached Bankok on 8th February, having revised the position of the main watershed between the Bay of Bengal and the Gulf of Siam. He records the longitude of Bankok from observation of an eclipse of one of Jupiter's satellites by Prince Tuanko Ta Noi, the second legitimate son of the late King of Siam, who is considered a very good observer.

> From the Prince I got Mr. Crawford's account of his mission to this court [III, 433–4]. ... I asked him, in return for the map I had given him, for any geographical information he had regarding Siam; he said none existed, and expressed his surprise at the extent and correctness of Mr. Crawford's information. He said he was anxious to get the King's leave to make a

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[1] Pemberton (98). [2] from Pemberton, 12-3-38; *JASB.*, VIII, 1838 (460–1). [3] ib. (219). [4] MRIO. 37 (25). [5] *JASB.* II, 1838 (70).

map of the kingdom from survey—but he was the only man in the country who could do it—he could expect no assistance[1].

The journals and sketches by Richardson and MacLeod[2] were "printed by order of the House of Commons in 1870", with a map[3].

Several maps of Moulmein and Amherst were made about 1841 by Captain O'Brien of H.M.'s 94th Regt[4]. One shows "the cantonment of Moulmein", scale 3 inches to a mile, and the Thoungyin River "where crossed by Dr. Richardson and Capt. McLeod". Another shews the "teak forests of Attaran & Ghyne rivers", and has a note "Dr. Woodford destroyed by a tiger on this spot"[5].

Amongst MacLeod's many journeys was one to the Chindwin in 1834, which he calls the "Kyendwen or Thanlawati" [III, 78–9][6]. In 1836 he left Moulmein with Richardson, and branched west into Upper Siam to cross the Mekong into Laos. His map extends north to Kengtūng in the Southern Shan States[7].

Another persistent traveller was Dr. George Bayfield, "of the medical establishment of Fort St. George". He made "a journey from Ava to the frontiers of Assam and back, December 1836 to May 1837", in company with the Burmese Governor of Mogaung, in order to discuss with British officers from Assam, the release of Assamese held captive by Kachins. His journal gives a good description of the route, the people, and the country, and a list of villages. His map, scale 8 miles to an inch, shows the Irrawaddy from Ava to Katha and Bhamo, and the route Mogoung–Mainkwan–Patkai Range[8].

Simon Hannay[9], one of these officers from Assam, made a map of "territory north of Ava, shewing route traversed during a journey from...Ava to the amber mines on the frontier of Assam", which passed through the Hukhawng, or Hukong, valley, and over the Patkai range to the Nawa Dihing in Assam.

Most of these routes were incorporated into Pemberton's map of the North-East Frontier which he compiled after the Bhutān expedition[10].

An undated map of the Shan States beyond the Salween is signed by A. H. Landers[11], and one of the An Pass from Arakan to the Irrawaddy, "by the Palm Leaf, or new route", by Frederick McGrath 1836, adjutant of the Arakan local battalion[12]. A nautical chart of the Moulmein River with soundings, from Amherst to Martaban, was surveyed between December 1841 and April 1842 by Lieut. W. Fell of the Indian Navy. It has a fine title-piece decorated with palm trees[13].

LOWER BENGAL

The only regular professional survey of this period was that of the Lower Brahmaputra which Wilcox had started in 1828 from Goālpara. He resumed the survey early in 1830, and just before Everest's return applied for an assistant to take observations along one bank of the river, and thus save the time of making frequent crossings [III, 16 ; IV, 2, 10, 198][14]. Ommanney joined in November 1830 and took over charge in September 1831 when Wilcox was called in to assist on the base-line and other important measurements at Calcutta [49–50, 352–3].

The survey was a troublesome one as the river channels fluctuate from season to season over a wide area. Though the surveyors worked generally from boats, they often had to make considerable journeys by land to follow up an important branch that was not at the moment navigable. The triangles were worked from short base-lines that Wilcox measured by "rods...formed of brass wire, one quarter of an inch in thickness, and 25 feet in length, supported by a trussed framework of deal wood"[15]. When Wilcox asked for advice Everest replied ;

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[1] *JASB.*, IX, 1840 (245). [2] 16m. to inch, MRIO. 91 (30, 31); *JASB.* IX, 1840 (28); ib. XI, 1841 (lxv). [3] Markham (99 n.). [4] also Bt. Capt. HM. 63rd Ft. [5] MRIO. 156 (62–5); 176 (3). [6] ib. 175 (14), (20). [7] DDn. 391. [8] Journal, DDn. 321 ; map, MRIO. 156 (4). [9] or Hannah. [10] MRIO. 98 (15) lithd. by Tassin 1838 ; *JASB.* VIII, 1839 (150) ; XI, 1841 (lxv) ; *PR.* 36 [11] ib. 157 (67). [12] ib. 156 (1). [13] ib. 176 (5). [14] Maps by Wilcox, MRIO. 169 (12) ; 171 (29–57). [15] *Gleanings in Science*, Dec. 1831 (337).

> It is certainly not in contemplation to extend the Great Trigonometrical Survey over the plains of Bengal further than Calcutta. ...
>
> If the base is long, it should certainly be more expeditious, more efficient, and more economical, to sink a permanent mark by means of a solid block of stone into each extremity than to go over the measurement again. A very large and strong picket might be driven into the soil if stone is scarce. If the overflowing of the river...be apprehended, I should prefer forming a supplementary triangle...out of reach of the water. Anything is better than measuring a base twice over. ...
>
> The removal of station marks used to take place sometimes in the Great Trigonometrical Survey, but the local authorities...put a stop to the practice. We found that natives did not generally move our marks unless they interfered with their tillage, or unless they suspected we had buried treasure there. The holiest man in the village will, if the affair be properly explained to him, be in most cases of great assistance [86][1].

Ommanney recounts that in October 1832

> I commenced my triangles...at the point of separation of the Brahmaputra and Jenai rivers (having found the stations I left there the previous year), and continued them down past the civil station of Mimunsing[2]. ... Below this the river becomes very shallow, and is only navigable for large boats in April when the river first begins to rise. The Lakya River branches off here, having a narrow, winding, but deep, stream, with steep banks, for the most part covered with jungle, so that it would be impossible to carry triangles down it.
>
> On the 1st of April I dropped down this river to Dacca for my measuring rods, and returned on the 13th. I then continued my triangles down the old channel of the Brahmaputra with the intention of measuring a base...at the first favourable ground. ... About the middle and latter end of May an immense quantity of rain fell; the river rose very rapidly and, not being able to find any good spot...for...a base, I secured my stations and gave them in charge to the thanadars[3], and on the 8th of June I left for Dacca to prepare my plans, calculations, etc.
>
> The total number of triangles from Jamulpoor to where I left off work is 209, with an average length of side of a mile and quarter. The average closing error is about 5″[4].

During season 1833–4 he brought the survey down to the junction with the Meghna, and then up the Dacca and Dulseri rivers to the Brahmaputra;

> On the 21st of May, as the rivers had commenced rising, I secured my station on the Dullesery River, and proceeded to continue the survey of the Brahmaputra River, but the rains set in so violently about the end of May that the work was much impeded, and on the 15th of June I left off the outdoor operations. ... As the place where I propose surveying next year is halfway between Cherra Poonjee and Dacca, I suppose there could be no objection to my remaining at Cherra Poonjee until the close of the rains. ...
>
> I propose this season to continue the survey down the Meghna connecting it with the series at Dacca, and also up the Dullesery River and Ganges to the head of the Jellinghy[5] [I : pl. 14 ; II, 14].

Resuming at the end of the rains he started another series of triangles down the Meghna towards Dacca till in December 1834 he received orders to abandon the survey and report at Dehra Dūn [355][6]. Everest did not think the survey could be adequately connected with the Great Trigonometrical Survey [10], and had asked Government for orders;

> The object originally proposed seems to be accomplished, that is, the existing course of the Burrampotra has been laid down, together with...the various creeks and channels. ... The Hon'ble Court of Directors will, of course, require...this survey for their Atlas, but there is no connecting any map, however, accurate it may be internally, with the other parts which comprise an Atlas, unless their relative latitudes and longitudes be known. ...
>
> As to the course of the Burrampatra, it changes like that of the Ganges and other Indian rivers, one year with another, so much, that no map can delineate its true features for any length of time. ... One of the arguments used for taking this survey in hand was the remoteness of the period at which the last survey was made[7]. ...
>
> Whenever survey of such wandering rivers be undertaken for purposes purely geographical, the chief object should be to select certain limits within which the river has ever been known to flow, and which there is no chance of its ever passing—to lay down those limits with accuracy—and to treat the existing course of the river as quite a subordinate affair. ...

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[1] DDn. 267 (37–9), 13–11–30. [2] Mymensingh [pl. 3]. [3] local heads of police. [4] to SG. 19–7–33; DDn. 330 (85–6). [5] Cherrapunji, 23–9–34; DDn. 318 (54–5); Memoir, MRIO. M 454. [6] Maps by Ommanney, MRIO. 171 (57–64); *Ben Regr Supply*. 6 (8); 172 (10–18). [7] by Reuben Burrow, 1787–8 (I : 158–9).

> The positions of several such land marks have been fixed, and the map...might be available... by connecting the nearest of these, the Baringa Pagoda, with one of the towers on the Barrackpore Road. ... If that connection were formed, the work...would be a geographical document of value. Without such a connection it strikes me to be a mere matter of curiosity[1].

Government reply was prompt. The survey was shut down the following month, leaving a gap of 30 miles north of Dacca, which would have taken about three months to close[2].

There was much unprofessional survey carried out during this period by officers and assistants of the Public Works Department, mostly for roads and protective embankments, and a whole-time Superintendent of Nadia Rivers was maintained for many years. John May held this post till loss of health compelled his resignation in 1840 [III, 484]. He was followed first by William Smyth, and in 1847 by John Lang, both of the Engineers. In a report on the history of the rivers, the latter tells of a survey of the Rājmahāl Hills carried out by May during 1831–2 after unusually heavy rains had caused serious changes in the channels of the Bhagīrathi, or Cossimbāzār, below Berhampore. Lang's report included several one-inch maps which shewed the changes at the outlet of the Bhagīrathi from the Ganges between 1821 and 1833[3].

Between 1832 and 1835 an elaborate survey was made by Joseph Cunningham on the right bank of the Ganges between Rājmahāl and Nadia for a major canal that should connect the Ganges and the Hooghly, and avoid the Nadia rivers which were too shallow and uncertain for navigation [I : 63–4 ; II, 19–21 ; III, 15–6]. The scheme was proposed by William Forbes [III, 448] and strongly supported by Johnston, Controller of Government Steamers [142][4].

The original fair sheets of Cunningham's survey are still preserved, 38 in number, scale 2 inches to a mile, with a ¼-inch reduction in two sheets[5]. The intake of the canal was to have been at the town of Rājmahāl and its discharge at the village of Mirzāpur, near Kālna on the Hooghly, about 20 miles below Nadia. To the south of the Ganges the survey shows a bank marked "probable limits of Ganges alluvion". Against the site of Gaur is a note added in 1850 ; "Depopulated in 1575 from the effects of the plague". The canal was never constructed[6].

In 1835, Lloyd, the Marine Surveyor [261 n.4], surveyed the Hooghly from Sāgar Island to Calcutta making a good connection with Everest's base on the Barrackpore road. He then surveyed the sea-front from Chittagong along the face of the Sundarbans—on to Hijli—and along the Orissa coast to Point Palmyras[7] [pls. 1, 3].

Large-scale surveys and maps were made of the environs of Calcutta by Charles Joseph of the Surveyor General's drawing office, and by Jean-Baptiste Tassin [III, 298–9][8]. Amongst Joseph's work is a survey of the Hooghly

> from Bandel to Garden Reach, exhibiting the principal buildings, ghauts, temples, &c., on both banks, ... with the great road from Calcutta to Hooghly, via Palta Ghaut. Executed in the year 1841. ... Scale 4 miles to inch. Size 9 feet by 2¼. Surveyed and elaborated by Charles Joseph. Position of places and course of the river laid down with mathematical precision ; they agree with the principal stations of the Great Trigonometrical Survey.
>
> Transferred and printed by T. Black, Asiatic Lith. Press [164 n.2], Calcutta[9].

There are river charts surveyed by, or for, the captains of river steamers. One, dated May 1839, shows "track of H.C. Steamer, Lord William Bentinck, from Jafarganj on the Ganges or Padma River, up the Jenai or Jabuna, ... to Jamalpur, and up the Brahmaputra River towards Goālpara"[10]. Another dated April and May 1849 is a survey of the "Mahananda River from Dulalganj, via Balia, Plassey, Malda, ... to Burgatchia (Ganges River junction)"[11].

The many road surveys by Public Works officers include several by James Crommelin and George Thomson of the Engineers, Robert Rose and Pennington of the uncovenanted service, and Alexander Daniell of the Revenue Survey office [192][1]. There is a map of the "Country between Moghal Serai and Mirzapore" by Alexander Cunningham[2].

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[1] DDn. 286 (157–60) ; 4–11–34 ; cf. ib. 371 (49–51), 12–3–37. [2] *As J.* XIX, 1836 ; As *Intell.* (7) ; *JASB.* IV, Jan. 1835 (63). [3] *Ben Sel.* II ; Markham (100) notes a svy. of lower Ganges by Fergusson 1835, pub. by Tassin. [4] *JRGS.* II, 1832 (316–8). [5] MRIO. 170 (1–38) (42–3). [6] DDn. 473 (5–9). 19–8–44. [7] Low, II (83) ; Chart, MRIO. 192 (11). [8] *Ben Regr.* 88 (222) & ib. *Supply*, 33 (S. 54). [9] Thos. Black ; *B & Agra Dir & AR.* 1835 (407), 1855 (344) ; IO. III. AC. 4 ; MRIO. Misc., Serampore ; Joseph, 1842. 170 yds. to inch. [10] MRIO. 172 (25–6). [11] ib. 169 (7–9).

CHOTA NĀGPUR

The hilly, woody, country from Chota Nāgpur southward through the Tributary Mahāls of Orissa, and hinterland of Ganjam, was inhabited by tribes of Dravidian stock, talking languages utterly different from those of the rest of India, and regarded as savage aboriginals. They followed no known creed, but adapted their lives to fears and superstitions regarding the spirits of their forests, peaks, and rivers—in modern parlance—animists. Of this family belonged the Santāls, Chuars, Uraons, Ho's or Kols, and further south were Khōnds, or Gōnds, and—with evil reputation for human sacrifices—the Merriahs [254].

During the years 1831 to 1838 waves of insurgence and unrest swept through these so-called "backward people", and necessitated military operations for which maps were urgently demanded[3] [253].

George Talbot of the Rāmgarh Battalion[4] offered to survey and map the whole area "without any emoluments", leaving it "to Government to renumerate me in any way they think proper", but Everest pointed out that

> the Court of Directors have given a very decided opinion against prosecuting perambulator surveys in general, and, as Chota Nagpore comes within range of the Longitudinal Series of the Great Trigonometrical Survey [III, 261–6], there can be no plea for making it an exception. ... Still, every addition that can be made to our geographical knowledge will be valuable inasmuch as it will materially tend to facilitate the progress of those trigonometrical operations which will eventually be carried on in those wild tracts[5].

Henry Kewney found a warmer welcome. In August 1832, he described his survey of part of Chota Nāgpur during the late Kol insurrection.

> It was long since I had done anything of the kind, and I found myself so out of practice that I was almost unable to do anything tolerable. The survey was taken with an instrument for taking angles made by a native artificer, and as it was not very true I could not rely upon the map being very correct [III, 148]. Also I was unable to give the latitudes and longitudes as I had neither the instruments nor the logarithmic tables requisite. ...
>
> A friend promised to obtain for me an introduction to you...at Barrackpore, ... when I had hoped...to have obtained your interest in procuring for me the appointment of surveyor of the...South-West Frontier. ... Whatever trial of my abilities ..you should wish, ... I am fully prepared. As to trigonometry, I believe I am pretty expert and also at the taking of latitudes and longitudes. I enclose a small specimen of my abilities at laying down a map[6].

His work was officially recognized, and two years later Everest reported that

> a theodolite by Gilbert was stolen from his tent when in the field, but under circumstances that leave no room for attaching blame to that officer. ...
>
> Ensign Kewney...requests permission to supply certain of his friends with copies of his map. .. As the young gentleman has received no remuneration nor assistance of any kind (beyond the loan of a few instruments), ... his request does not appear to be altogether an unreasonable one, but if the...Council should be pleased to award a small sum in the way of compensation...the map would in that case be exclusively public property, and no copies could be issued without a special order of Government. ...
>
> The map, altho' perhaps not of much value in a geographical point of view, may still be considered a useful addition...in the office of the Surveyor General, ... inasmuchas that it gives a tolerable accurate delineation of a tract...of which no previous survey has been made[7].

Two of Kewney's original surveys are preserved ;

> Map of part of Chota Nagpore and Burwa, including the route of the 50th Regt. N.I., from Tikoo to Burwa, 1832. Scale 2 m. to inch. Shows country between Koel and Sank Rivers. Hills brush-shaded. [Heading shows two stalwart tribesmen, with the battalion in action][8].

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[1] MRIO. 46 (5); 47 (6); 48 (3), (14–5); 52 (20), 63 (5, 23); *Ben Regr.* 6 (26, 29, 30–2, 35).
[2] MRIO. 31 (82).
[3] DDn. 284 (45), 1–4–32.
[4] Geo. Richd. Talbot (1801–53); Ben Eur.; Eng. 1819; Lt Col. 1848; Hodson, IV (232).
[5] DDn. 266 (168–9), 17–4–32.
[6] DDn. 284 (145–8), 4–8–32.
[7] DDn. 286 (152–3), 30–7–34.
[8] MRIO. 63 (1).

> Route survey of parts of Burrabhoom, Patcoom, and Sukurbhoom Jungle Mahals. ... Scale 1 m. to inch. Hills brush-shaded. Survey falls east and west of Subarnarekha River, and north of Dubna Hill in Manbhum District[1].

The Survey museum at Dehra holds "a reconnoitring survey of the Cantonments at Dorunda near Ranchi : scale 200 paces to an inch, surveyed and drawn by Gerald Hervey, ... doing duty with the Ramgurh Light Infantry, 9th December, 1840". Another plan of Doranda was made in 1838 by Samual Tickell, who made several surveys in Chota Nāgpur, as also did Markham Kittoe[2] and Edward Haines.

UPPER PROVINCES

The contribution made by the revenue surveyors of the Upper Provinces to the topographical maps and large scale town surveys is described elsewhere [8, 209, 211 n.5]. Other towns and cantonments, besides major roads, were surveyed by officers of Engineers, of Public Works, and of the Quarter-Master General's departments. Plans of the Dūn and Mussoorie made by William Brown's party in 1839 and 1842 give names of property owners [220–1 ; pl. 17][3].

There are surveys and maps of canals, such as an undated map for the lay-out of the Rājpur Dehra canal "compiled from village maps with the Superintendent of the Dun", signed by Proby Cautley, Superintendent of *doāb* canals[4].

A military sketch of Kumaun, made by Septimus Becher in 1838 gives particulars of suspension bridges, and of the Gurkha guard posts along the Kāli River[5].

One of the earliest maps of Simla, made by William Garden [III, 450], scale 600 yards to an inch, was engraved by Tassin in 1830[6]. Lord Amherst had spent the summer months of 1827 there. The first permanent house had been built by Captain Kennedy in 1822, but in 1830 there were still only 30 houses.

During the rains of 1839 Alexander Cunningham and Arthur Broome made extensive exploration of the hills from the Sutlej to the Jhelum "to ascertain the sources of the Punjab rivers and...collect every kind of information". Starting northwards from Simla they crossed the Sutlej at Rāmpur on 19th June and worked up the Beas into Lahul and then separated. Broome worked eastward up the Bhāga and down the Spiti, to return to Simla, whilst Cunningham went down the Chandra-bhāga and Rāvi rivers into Chamba, to reach the plains at Pathānkot. From there he visited Jammu, and called on Rāja Udham Singh (eldest son of Ghulāb Singh), who was shortly afterwards killed at Lahore in the quarrels that followed the death of Ranjīt Singh[7]. From Jammu he travelled up to Kashmir by Rājaori and the Pir Panjāl Pass [291], reaching Srinagar on 15th September[8].

The results were mapped in two sheets on the quarter-inch scale, which shewed the rivers, roads, and place names in considerable detail, with boldly drawn hills. Cunningham's 8-mile reduction was entitled "Map of the Alpine Punjab"[9]. These maps reached the Surveyor General without "fieldbook, journal, or memoir, and differed generally from Trebeck's maps [III, 43] by over 4 minutes in latitude"[10].

Amongst the road surveys of this period was one of the Agra–Bombay high-road started by John Drummond of the Quartermaster General's department [III, 440], who in 1839 asked the Surveyor General for values of points fixed by the Great Arc in Gwalior. This request was repeated by William Abercrombie, Executive Engineer, who reported that he had been obliged

> to relinquish the survey of the road...via Seepree towards Gwalior at Ghatee Gong (marked Soojurma in Colonel Fielding's map [III, 447], distant from Gwalior 23½ miles), as the needle is so much affected by the magnetic iron ore abounding between that village and Gwalior. ... It having been intimated to my predecessor by the Surveyor General that the

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[1] MRIO. 55 (26, 27) ; 62 (36). [2] MRIO. 19 (32), 38 (12), 46 (4–7), 48 (14, 15), 59 (32), 63 (23, 25) ; 186 (15). [3] MRIO. 17 (1–11) ; lithd. copies, E. & W. "Doon" ; GBO. Lib. A-2, 3. [4] GBO. Lib. folio A-1 ; see also MRIO. 169 (18) ; 170 (1–38). [5] MRIO. 170 (46). [6] *IO Cat.* (54). [7] Ranjīt Singh d. 29–6–39, Grey & Garrett (appx. i, v.). [8] *JASB.* II (1–6, 105–15). [9] MRIO. Misc. 8–0–39 ; *IO Cat.* (232). [10] DDn. 453 (130–1), 14–2–44.

> furnishing information from his office without sanction by Government was irregular, I solicit... that I may be supplied from the Surveyor General's office with a map [253]. ...
>
> The country between Soojurma and Gwalior is not open so as to admit of the line of road being laid down readily by angles taken to fixed points, and...I have not the necessary establishment to...survey this distance without using the magnetic needle. ... The scale on which my general map of the road is to be drawn is 4 miles to the inch, and should the furnishing me with a sketch by the Surveyor General...[involve] any considerable delay, ... I propose compiling the unsurveyed portion...from Colonel Fielding's map, a copy of which, ... to a scale of 5 miles to the inch, is in possession of the Resident at Gwalior[1].

CENTRAL PROVINCES[2]

Absorbed as he was with the scientific and practical problems of his Great Trigonometrical Survey, Everest was not altogether indifferent to the romance of exploration. In the "hurry and bustle" of preparing for his own journey "up country" at the end of 1832 he despatched his two latest recruits, Andrew Waugh and Thomas Renny, to march from Calcutta to south Gwalior, to spend a field season under the wise tutelage of William Rossenrode [24]. To excite their appetite for geography and an interest in their long journey, he directed them to explore the high ground whence flowed the three great rivers, Narbada, Sōn, and Māhānadi. He asked Government to approve the survey

> of the Soane River...to its source, and...such enquiries and surveys in the neighbourhood of Amarkantak...regarding the courses of the Arah, Nerbuddah, and Mahanuddee as will enable me to fill up part of the vast gap marked at present by the...undiscriminating title of 'unexplored country'. ... It detracts greatly from the value of the expensive Atlas...now constructing that the geography of so large a portion...should rest entirely on the meagre description of Major W. Bruce who went to explore in 1771 [I : 29–30, 315]. ...
>
> The Soane is an important river, as affects both internal navigation and agriculture; so are the Nurbuddah and the Arah. ... From the circumstance of each of the two former having its source in the same lake, and running, the one to the westward...the other to the eastward, ... whilst the third, after uniting with the other branches of the Mahanuddee, flows on through the province of Cuttack until it meets the sea a little below Point Palmyras, it is concluded that the lake...at Amarkantak is the most elevated land in Central India [III, 88–9][3].
>
> This does not follow...as a necessary consequence, for it is just as likely that Sohawah, near Concair[4] about 182 miles to the south of Amarkantak, where the principal branch of the Mahanuddee has its source, is the most elevated spot. ...
>
> Lastly comes the consideration that the country...may...hereafter be the scene of discord and rebellion. We know it has many odd hiding-places. ... Now, whilst the tract is at peace, is the time to avail ourselves of the opportunity of getting information, as a preliminary step to which I have directed...Lieuts. Waugh and Renny to explore, ... yet it is not from a hasty journey of that sort that full local information can be obtained.
>
> Accurate surveyors...seem the first substantial step, ... and fortunately the Government have...the services of Lieutenant Pemberton, an officer of great merit, who is now disposable I...recommend that Lieut. Pemberton be authorized to undertake the survey [263][5].

Pemberton's transfer did not take place, but Waugh and Renny had a most interesting journey. Everest gave them clear instructions and copies of earlier work, including part of his own route of 1818 [III, 227, 442 ; IV, 336] ;

> I leave it to your judgement to examine...any portion of my route again. You may perhaps lay down the hills more accurately, ... and, as it was a...hasty performance, you may, if you find any errors, correct them. ...
>
> The tract to the southward of...Songurh leading to Omurkuntuk is absolutely terra incognita, and it is one of the most interesting parts of India, both geologically and geographically. The route I wish to be explored is that leading to Omurkuntuk from Rajgurh on the Soane. ...
>
> Your latitudes and longitudes will all be referred to the nearest principal stations of the longitudinal series...whenever you can manage to discover them.

---

[1] to NWP. Govt. DDn. 401 (250-1), 29-1-43. [2] formed from 1852 from seven British dists. of the Saugor & Narbada Territories combined with territories of Nāgpur Rāja [III, 90 ; IV, 229]. [3] highest point, 16 m. N. of Amarkantak 3,694 ft. ; Gāwilgarh Hills, N. of Ellichpur, 3,864. [4] Konkeir [pls. 1, 23]. [5] DDn. 283 (209–13), 22-11-32.

> Having explored the route to Omurkuntuk, you will proceed...along the northern bank the Nerbuddah to Jubbulpore, and from thence to...fall in with...Mr. Rossenrode[1].

They had no trouble with the inhabitants, and "travelled...without parwanas". They left Sherghāti on 23rd December, and on the 25th passed one of the old telegraph towers, milestone 307 from Calcutta [III, 271]. They followed the trunk road "as far as the dawk bungalow at Mundunpoor", where they turned off, to reach Chunār by way of Rohtās[2]. They then struck south and fixed the geographical position of Amarkantak to half a second, with height by barometer 3728 feet above the sea.

They reached Jubbulpore on 10th March 1833, and joined Rossenrode early in April near Sipri, about 80 miles south of Gwalior [24 : pl. 4][3]. Traverse was kept by theodolite and perambulator; heights were recorded from barometers in correspondence with the standard at the Calcutta office, and "with Mr. Prinsep's standard at the Assay office". Their geological notes and sketches show considerable knowledge of the subject. The journal was illustrated with bold, artistic, pen-and-ink sketches by W. H. Scott, their draughtsman. Sub-assistants Martin and Radhanath Sikhdar completed their technical staff [372][4].

A survey of Everest's own route, leaving Mirzāpur on 6th February 1833 and reaching Saugor on 6th March, was kept by John Peyton and the apprentices under instruction. The journal was closed on 21st May at Mussoorie[5].

These two routes were compiled with other material into a map of the country south from Palāmau as far as Hyderābād[6], which comprised surveys of

Nagpur, Norris and Weston [III, 92–3]—Bhopal, Johnstone [III, 87–8]—Narbada valley, Robb [III, 87]—South-west frontier, Smith [II, 47]—Sirguja, Ferguson [III, 88]—Rewah, Lindesay [II, 47]—Chattisgarh, Lloyd [II, 53]—Chunar to Yertnagudam, Blunt [I : 59–63],

and lastly Everest's own route survey, Chunār to Hyderābād[7] [270].

Amongst other surveys of Central India and Nāgpur of this period, mostly from road engineers, are two made by Dr. Spilsbury during "the settlement by *panchayat* of the boundary between Rewah and Kotah States", December 1838, including a "march from Brimham Ghat on the Nerbuddah to Umurkuntuk, the source of at river [288]".

RĀJPUTĀNA

Since 1828 Alexander Boileau had been laying down a basis of traverse and triangulation along the western frontiers of Agra and Muttra in preparation for a regular survey of Bharatpur State, which he was not allowed to enter till October 1829 [III, 26–7]. He then carried work into Bharatpur and Dholpur, fixing the more prominent hills by triangulation, and running long traverse circuits through the flat country. The following extracts are taken from his journals of 1830–31[8]:

> During November continued this survey...as far as Raja Khera, chiefly in the Dholpur country. Marched into Agra...to prepare for the trigonometrical survey of Bhurtpoor. ... Spend December surveying south-west Bhurtpoor. ...
>
> During the month of February 1831, various lines have been carried through the northern part of Bhurtpoor State, about 70 running miles of traverse. ...
>
> March 1831 was a very busy month, and the results...highly satisfactory, for the distant cities of Mowha, Burawar, have been connected with the capital...by an unbroken line of 108 running miles, and the survey has been checked by a comparison with the measurements of 1828, which established an error of little more than half a furlong in a route of nearly 80 miles[9].
>
> The whole of October 1831 was employed in connecting various broken lines which had been partly surveyed during the last season, chiefly to the south-west, ... also in connecting the measurements throughout the Bhurtpoor country with those upon the Agra and Muttra frontier. ... November 1831, a very heavy month's work. Survey carried up to the northern

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[1] DDn. 276 (169–73), Nov., 1832. [2] part of the distance measured by pedometer. [3] DDn. 378 (1–2), from Waugh 2–4–33. [4] with practically no dates, Journal, MRIO. M 263; 10 Maps, MS. 35; Maps, MRIO. 62 (5), 63 (5), 71 (12–5); Geological maps, ib., 76 (17–9). [5] Everest himself reached Saugor 3rd March, and Mussoorie before 10th May [163]; Journal MRIO. M 237; plotted traverse, ib., 33 (33–6). [6] MRIO. 77 (7). [7] MRIO. Misc. 21–0–38. [8] Journals, DDn. 275–6, M 527, 318. [9] a town in Bharatpur, 54 E/2.

> extremity of Bhurtpoor State. ... The operations of January 1832 have been chiefly confined to the north-western frontier, ... laying down the boundaries with...Alwar.

His fieldbooks and journals are beautifully neat, and decorated with attractive pictures of Rājput forts. Early in 1832 he was called off at Everest's request to run an approximate series for the Great Arc northwards from Sironj towards Agra, and he writes that,

> being interrupted in my survey...at the very commencement of the month of March 1832, owing to my meeting with the Governor General in camp at Busawar[1], the progress report of this month will detail little else than my movement towards Seronj...to take up a new line through the Mahratta country as recommended by the Surveyor General[2].

In September 1834, after two full seasons on the Great Arc under Everest [23–37], Boileau was ordered "to Kurnal to join the corps now marching against Jodhpur", on what became known as the "Shekhawat Expedition"[3]. Though sent "to settle some disputes with the State of Jodhpur, the main end of that expedition", writes Everest, "seemed...solely the extension of geographical information, for to that object everything else was made to give way".

Boileau was accompanied by John Thornton, a young sub-assistant of the Trigonometrical Survey, and, under the orders of Henry De Budé [III, 437 ; IV, 83], was employed largely on survey with Saunders Abbott and others[4]. He writes on 1st December ;

> We arrived in the Shekhawatee country yesterday, and are now waiting for orders before the work of demolition commences ; hill forts and plain forts...round us in every direction, and the Engineer's department is fully occupied in making plans of them. Our officers are dispersed...chiefly on surveying duty, and the whole of the route work falls on my shoulders. ...
>
> Having three corps of cavalry, six battalions of infantry, five companies of European artillery, and a thousand sappers and miners in the field, besides twelve battering guns, ten heavy mortars, four heavy howitzers, and ten field pieces, ... there is not likely to be much fighting, for none of the chiefs could make head against such a force, but...we shall be kept out for many weeks blowing up, or pulling down, the strongholds of these border robbers[5].

On the conclusion of operations a few weeks later, Boileau was attached to a political mission that was to settle various boundary questions towards Bahāwalpur ;

> The field army is now dispersing. ... The Engineer Department is also being broken up, and our officers are dispersing, ... but I am not so fortunate, ... being directed to accompany Major Alves's assistant, Lieut. Trevelyan, ... to Beekaner, and from that place towards the Indus, returning by way of Jaisulmer, Balmer, and Jodhpoor, to Agra. ... A part of Mr. Trevelyan's duty is...to settle a boundary dispute between the Rajpoots and Mussulmans on the Buhawulpoor frontier. ...
>
> The whole of the time, since the troops marched from Sambhur[6] at the end of November, has been employed in making a general survey of the country, with plans and sections of any forts that could well be seen or heard of, and the Sappers and Miners have been...digging down, or blowing up, such...as were condemned on account of their harbouring robbers[7].

This journey broke new ground, and was of great geographical interest. Boileau joined Trevelyan at the camp of Major Alves, A.G.G. Rājputāna[8], at Patun, which they left on 26th January 1835 to march to Bikaner, where they halted two weeks before marching west to Jaisalmer. Here Boileau accompanied Mackeson, of the political department, to Mithankot on the Indus, and then to Bahāwalpur[9]. Returning through Bikaner, they worked south through Phalodi, to spend three weeks at Barmer, then east to Jodhpur, 1st August, and Jaipur, where they found Alves. Boileau finally got back to Agra on 23rd August.

He has left a very full account of his work on the expedition and of the tour to the western frontiers in his *Personal Narrative of a Tour through the Western States of Rajwara in 1835, comprising Beekaner—Jesulmer—and Jodhpur, with the passage of the Great Desert, and a brief visit to the Indus and to Buhawalpoor*[10].

The maps produced included a "large map of Shekhawutee, made by the Engineers of the Field Force, a small portion being borrowed from MS. Map by

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[1] 30 m. sw. of Bharatpur. [2] MRIO. M 318. [3] Shekhāwati, about 60 m. N. of Jaipur. [4] route Agra to Sambhur by Engr. officers attd. S. & M., Oct. 1834 ; MRIO. 29 (18). [5] to SG., DDn. 331 (28), 1–12–34. [6] 40 m. w. of Jaipur. [7] to SG., DDn. 331 (59), 22–1–35. [8] Nathaniel Alves (1788–1875) [II, 376 ; IV, 155] ; AGG. Rājputāna, 1835–40. [9] Jaisalmer 6–4–35, to Bahāwalpur 1–5–35. [10] pub. Calcutta, 1837.

Lt.-Colonel Hall" [III, 456][1]—route surveys by Boileau himself—survey of the Panjnad from Mithankot to Bahāwalpur by Nathaniel Hodges, a surveyor employed by Wade, Political Agent at Ludhiāna [219]. Whilst on a mission to Bahāwalpur Wade had been deputed in 1832 "to survey the Sutledge, and complete the arrangements...for opening the navigation of that river in connection with the Indus" [244, 274], and had borrowed Hodges from the Delhi revenue survey[2].

Boileau also compiled a map of west Jodhpur from route surveys by the Quartermaster General's officers, Frederick Sandys and Bellew [III, 423, 500 ; IV, 293] and the Bombay officers Burnes and Holland [III, 132–3]. His book contains a map, scale 12 miles to an inch, covering an area 25° 50′ to 29° 30′ N. by 70° 20′ to 76° 20′ E.

The papers handed in by Boileau after the political tour cover a wide range of interests ;

> Journal of a tour through the States of Beekaner, Jaisalmer, Buhawulpoor, Jodhpoor, and Jaipoor, from...January to...August 1835.
>
> Local memoranda respecting the soil, climate, productions, forts, cities, roads, etc. ...
>
> Statistical tables showing...detail of population and trade of various cities and towns..
>
> Memoranda on the language and literature of the above countries.
>
> A general map of the routes traversed by Lieuts. Trevelyan and Boileau. ...
>
> A particular map of the western parts of Marwar, comprising the districts of Mulanee, Mewar, ... etc., lying between Jodhpoor and Sind.
>
> Plans of the *Shuhur Punahs* on town walls, and of the citadels of Beekaner, Jaisulmer, and Jodhpoor.
>
> Views of the fortresses and other interesting objects at Jaisulmer and Jodhpoor[3].
>
> Field books of various surveys, and
>
> Astronomical observations for ascertaining the latitudes and longitudes[4].

He gives the following technical details ;

> Nearly the whole of the observations for latitude, etc., ... were taken with an excellent 8-inch sextant with a false horizon, a very superior instrument, which has been in constant use for several years. The observations for magnetic variation were taken with a 3½-inch theodolite, my own property, which has...an unusually long and lively needle. And all the observations for time, and relative or absolute longitude, depend upon a very tolerable chronometer, assisted by the above-mentioned sextant and a refracting astronomical telescope of 46 inches focus, all...the property of Government, as well as the remarkably steady Madras perambulator with which...my measurements were made [I : 198–9 ; IV, pl. 7].
>
> After coming within...the desert it was found almost impracticable to keep up a regular field book, partly owing to the rapidity with which we were marching, and partly in consequence of the heat. ... It became necessary to adopt some other method. ...
>
> The latitude of our camp was observed daily, either by a meridian altitude of the sun or a star, or by the nearly simultaneous observations of different pairs of large stars. The marching distance from the last camp was measured by the perambulator, and the general direction of the day's route was observed with a theodolite, with which...bearings were also taken to... all villages. ...
>
> Every now and then the dead reckoning of the route was checked by calculating the difference of longitude between camp and camp as determined by the chronometer, with the observed hour-angle of the sun or a star. ...
>
> Though the mainsprings of three of my pocket watches were broken during this season, yet...the mainspring of the chronometer remained uninjured. ... The positive longitudes assigned to the principal fixed points...[depend] on only four eclipses of Jupiter's satellites[5].

Of the officers of the Quartermaster General's department[6], Hall had surveyed Ajmer, Jaipur, and Jodhpur during 1820–1 ; Sandys had surveyed Jaipur and "Amir Khan's country" during 1824–5 [III, 87] ; whilst Bellew, who had been on the Shekhāwati expedition, surveyed Tonk, Udaipur, Jaipur, and Bundi during 1836–7[7], and with George Whish surveyed Alwar during 1840. A copy of the latter survey bears a note that "Lieut. Whish's survey is indifferent compared with Captain Bellew's ; the former was a novice in surveying ; the latter a good practiced hand"[8].

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[1] MRIO. 82 (34). [2] from Sec. to GG., DDn. 281 (29–33), 9–8–32 ; map, MRIO. 160 (4–5), Journal, *IO Cat.* (234) surveys embodied in *Map of the Sikh Territory*...John Walker, 1846, MRIO. 84 (31–2) ; *Imp Gaz.* VI (196). [3] Bikaner City, MRIO. 187 (24) ; Rājwara, MRIO. 84 (36) ; landscape views, ib. Misc. 5–6–35. [4] DDn. 331 (51–2) ; 12–8–35. [5] Boileau (293–4). [6] ¼-inch map of Jaipur, compiled by SGO. 1840, MRIO. 82 (23–4) ; 4 m. to inch. [7] MRIO. 83 (50–1). [8] ib. 82 (1–5).

TRANSFRONTIER EXPLORATION ; ALEXANDER BURNES

Burnes had closed his journey of 1831 up the Indus, Chenab, and Rāvi, by his arrival at Lahore on 18th July, and formal reception by Ranjīt Singh two days later [243]. He stayed at Lahore for nearly a month, and made friends with the French officers in Ranjīt Singh's service, finding in Mons. Court especially an enthusiastic geographer after his own heart[1].

> M. Court struck me as an acute and well-informed person ; he is both a geographer and an antiquarian. ... He showed me the route from Kermanshah, by Herat, Candhar, Ghuzni, and Cabool, to Attok, constructed...with great care. ... He had been less anxious to obtain a complete map...than to ascertain one good route...and the resources of the country.
>
> The French have much better information of these countries than ourselves. ... M. Court... has likewise employed a residence of four years in the Punjab to illustrate its geography. He has encountered jealousy from Runjeet Sing, but still managed to complete a broad belt of survey from Attok to the neighbourhood of our own frontier[2].

Summoned to Simla to make personal report, Burnes stayed ten days with Wade at Ludhiāna, and then six weeks at Simla, where discussions with the Governor General, Lord William Bentinck, on the opening up of the Indus to navigation, led to Henry Pottinger's mission to Sind and Wade's visit to Bahāwalpur [244, 273].

Bentinck now gave Burnes authority to make a more ambitious journey through Afghānistān to Bukhāra, the great city of Turkistān, to obtain information on local politics and geography, and the threat of Russian infiltration [pl. 16].

> The design received the most liberal encouragement from...Lord William Bentinck. ... I was furnished with passports as a Captain in the British army returning to Europe, drawn out in French, English, and Persian. I received...sanction...to associate with me Ensign John Leckie...who had been the companion of my voyage up the Indus [243]. On the eve of departure my fellow-traveller was recalled by the Government of Bombay. ... I prevailed on Mr. James Gerard [III, 452-3], ... a surgeon of the Bengal army, to accompany me. ...
>
> I was also attended by a native surveyor, Mahommed Ali, ... who had been educated in the Engineer Institution of Bombay under Captain G. Jervis [III, 384 ; IV, 243 n.1][3].

During October Burnes accompanied the Governor General to Rupār, on the banks of the Sutlej, where state visits were exchanged with Ranjīt Singh, and he then withdrew to Ludhiāna to finish off his maps and reports of the Indus. He took these to Delhi in December to receive his final instructions and papers, and recruited a young *pandit*, or self-styled *munshi*, by name of Mohan Lal, who was to maintain the daily journal and otherwise make himself useful [401-2]. Returning to Ludhiāna he picked up Dr. Gerard, and the party started on their long journey on 2nd January 1832, armed with a permit from Ranjīt Singh[4].

After a stay at Lahore the party left on 11th February, throwing out superfluous baggage. From Rāwalpindi, as they were leaving Sikh territory for Muslim, they adopted Afghān dress, and further reduced their baggage to two mule loads. Crossing the Indus by ferry at Attock, they spent a month in Peshāwar, moving forward on 19th April by the Kābul River route ;

> We crossed the river of Cabool above Muchnee on a raft which was supported on inflated skins. ... The river is only 250 yards wide, but runs with such rapidity that we were carried more than a mile down before gaining the opposite bank. The horses and baggage ponies swam across. On the 23rd we had adjusted all matters for our advance by conciliating the Momunds...through whose country we were to pass. ...
>
> After a fatiguing march over mountain passes we found ourselves on the Cabool River which was to be crossed a second time. ... Its breadth did not exceed 120 yards. Towards afternoon our highlanders produced eight or ten skins, and we commenced crossing, but it was night before we had all passed. On the following morning we reached Duka[5]. ... We could see the town of Julalabad forty miles distant[6].

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[1] v. Biog. Notes, sn. Court ; also Grey & Garrett. [2] Map of Afghān roads, MRIO. III (3) ; Journal, Yezd–Herat–Kabul, *JASB.* XIII, 1844 (827-52) ; cf. Vigne, I (119) ; *Bokhara*, I (136). [3] *Bokhara*, I (ix). [4] *JASB.*, I, letter from Burnes, Lahore, 23-1-32. [5] Loe Dakka, w. end of Khyber Pass. [6] *Bokhara*, II (97-100).

They reached Kābul on 1st May and were warmly welcomed by Dost Muhammad. On the 18th May they set out on the adventurous part of their journey, attended by three capable men who knew the country. "We were not now recognized as Europeans by any one, which...gave a pleasing liberty to our actions". They crossed the "Hajeeguk" Pass, 12,400 feet above the sea, and on the 26th

> crossed the last pass of the Kara Koottul, or Black Pass, but had yet a journey of ninety-five miles before we cleared the mountains. ... There were only eight persons in our party, and three of these were natives of the country ; two others were instructed that they were quite distinct from us, though one of them noted the few bearings of the compass, which I myself could not conveniently take without leading to discovery [243][1].

This was Muhammad Ali, the surveyor who, "generally travelled as a pilgrim travelling to Mecca, holding little or no open communication with us".

They reached Haibak, the first town in Uzbek country [pl. 16] ;

> Our character was never suspected and, so beautiful a starlight night was it, that I did not let this, the first opportunity, pass without observing our latitude north of the Hindoo Koosh. We set out in the morning before the sun had risen. ...
>
> On the 30th of May we made our last march among the mountains and debouched into the plains of Tartary at Khooloom, or Tash-Koorgan, the frontier town of Moorad Beg of Koondooz, a powerful chief who had reduced all the countries north of Hindoo Koosh to his yoke.
>
> Since leaving Cabool we had slept in our clothes, where we could seldom or never change them. We had halted among mud, waded through rivers, tumbled against snow, and for the last few days been sunned by heat. These are but the petty inconveniences of a traveller, which sink into insignificance when compared with the pleasure of seeing new men and countries, strange manners and customs, and being able to temper the prejudices of one's country by observing those of other nations. ...
>
> We entered Khooloom with an intention of setting out next day on our journey to Balkh, ... when, to our surprise, we learned that the officers of the customs-house had despatched a message to the chief of Koondooz to report our arrival. At midnight on the 1st of June I received a summons to repair to Koondooz with all despatch[2].

Murad Beg, the Uzbek chief of Kunduz, was the ruffian who had held up Moorcroft for several weeks in 1825, and fleeced him of about 20,000 rupees. Leaving his party at Tashkurghan, Burnes rode the sixty miles to Kunduz, assumed the role of an unpretentious Armenian and, being nobly supported by one of his Kābul retinue, escaped detection, and was allowed to rejoin his companions and proceed.

As they passed Mazar-i-Sharif and Balkh they collected information about Moorcroft's fate [III, 486–7, 508] ; "He and his associates perished of fever, not without suspicions of some more violent death. A more encouraging field lay before us. ... We had none of the wealth of the English traveller which...proved his ruin".

Crossing the Oxus on the 17th June, Burnes and his party reached Bukhāra on 27th. Though politely treated, they had to put up with the various irksome restrictions imposed upon outsiders ;

> On the 21st of July we made our farewell to the vizier. ... We were not to be distinguished from the natives of the country, for we had adopted their dress and habits. ... I cannot say I felt much regret at clearing the gates of the city, since we should now be more free from suspicion, and able both to ride and write. We had, indeed, managed to use the pen at night with leaden eyes, but, even then, we did it with fear[3].

They now travelled south-west through Turkman country, in company with a caravan of merchants bound for Persia, but were unexpectedly held up for several weeks at Karakul, awaiting permits from Khiva for the onward journey.

> About midnight on the 10th of August, when we had almost despaired of the return of our messenger, we were roused...with the joyful information that the chief of Orgunje [Khiva] would not offer any obstacle to the advance of our caravan. ... He gave us a frightful account of the desert south of the Oxus, and the great difficulties of finding the road, which was now hidden by clouds of sand that were disturbed by the wind. ... We...hired two extra camels which were to be the bearers of six skins of water.
>
> Our stay near Karakool had now been prolonged to the middle of August. ... On the morning of the 16th...there appeared about eighty camels to prosecute the journey to the Oxus, all of them laden with the precious skins [astrakhan lamb]. ...

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[1] *Bokhara*, II (151–72). [2] ib. (176–80). [3] ib. (277) ; cf., *JASB*. I (145) ; II, 1833 (1).

> At midday...we commenced our march on the Oxus, which was about twenty-seven miles distant. ... Our route led us amongst vast fields of soft sand, formed into ridges. ... The belt of these sand-hills...between Bokhara and the Oxus varies in breadth from twelve to fifteen miles. ... None of the hills exceeded the height of fifteen or twenty feet. ...
>
> We had come down upon the Oxus at Betik...opposite to Charjooee, and one of the greatest ferries between Persia and Toorkistan. ... We found the stream of the Oxus with a breadth of 650 yards, and in some places 25 and 29 feet deep[1] [pl. 16].

They had a very difficult march across the desert, and passing to the west of Merv reached Sarakhs on the Tejend River on 2nd September. "After a detention of ten long days" they were at last allowed to enter Persia. "At dawn on...of the 14th...we found our caravan waiting...under the walls of Meshed. At sunrise the keys of the gate were brought, which was at once thrown open to us".

After ten days at Meshed they marched to the Prince Royal's camp at Kochān, where the party broke up, Burnes to visit the Caspian Sea, and Gerard, whose health was very poorly, to return to India via Herāt.

> Since we had entered Khorasan, ... Dr. Gerard had come to the resolution of turning down upon Herat and Candahar, and thus retracing his steps to Cabool. ... The main object of our journey had been now nearly accomplished, and the route of Herat...had been travelled in safety by Lieutenant Conolly [283]...and some of the French officers of Runjeet Singh [274].
>
> At Koochan I also permitted the Hindoo lad [Mohan Lal] to return to India along with Dr. Gerard, and at his own request I discharged my faithful Afghan servant who had accompanied me from Lodiana. His name was Sooliman, a native of Peshawar. He had both kept my secrets and my money where there were many inducements to betray[2]. ...
>
> On the 29th of September I bade farewell to my fellow travellers and the officers of the Prince's service, and commenced a visit to the shores of the Caspian[3].

Burnes had a comparatively uneventful journey to the Caspian, and then to Tehrān, where he reported to the British envoy, and called on the Shah. Leaving Tehrān 1st November, he returned to Bombay by sea from Bushire;

> We anchored in the harbour of Bombay on the 18th of January [1833], and passed the rest of that month in quarantine, after which I proceeded without delay to Calcutta, to lay the result of my travels before the Governor General[4].

Gerard had a long and exhausting journey back through Afghānistān, and was a very sick man. A full account of the journey is given by Mohan Lal, who proved a tower of strength. Owing to Gerard's illness they spent two months in Meshed, not leaving till 5th December 1832. They reached Herāt on 31st December, and stayed there more than seven months. They then made Kandahār 25th August 1833, Kābul 5th November, and Lahore 30th January 1834.

Gerard kept up a survey from Herāt to Peshāwar though carried most of the way in a litter. He never recovered his health, and died at Sabāthu in March 1835. His brother Alexander [III, 451–3] worked up the maps, and wrote a memoir;

> His trip to Bokhara...was a mad-like expedition for him, as he had long been unwell, and was obliged to leave his bed to go, and could only travel in a palkee. It was, however, his own wish...that Burnes applied for him. This trip killed him, for he had several attacks of fever on his way to Bokhara, and Burnes again and again urged him either to return or stop at Kabool till he recovered. But he would do neither. ...
>
> On his return he was detained three months at Meshed, and no less than eight at Herat, by fever, so after his arrival at Soobathoo his constitution was completely worn out. ... I got leave...on purpose to prepare a map of his route from his notes, for he observed the bearings, estimated the distances, and noted the villages all the way from Herat to the Indus[5].

The map, in 8 sheets, shows George Forster's route of 1783 [I: 233], which followed the Khyber Pass, whilst Gerard had closely followed the windings of the Kābul River. It carries many interesting remarks such as names of tribes and districts, products of the country, and the abundance of orchards and robbers[6].

Burnes' account of these remarkable *Travels into Bokhara* was published in London in 1834[7], together with his *Narrative of Voyage on the Indus...with presents*

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[1] *Bokhara*, II (282–303); III (1–7). [2] presumably Muhammad Ali accompanied Burnes to the Caspian. [3] *Bokhara*, III (83–6). [4] ib. (121). [5] Aberdeen, 18–10–39; Lloyd, I (283–6). [6] Originals & copies 5 m. to inch, MRIO. 116 (8–23); sgo. reduction, 8 m. to inch, ib. Misc. 16–O–33; *IO Cat.* (474). [7] by John Murray, 3 vols.; *v. JRGS.* IV, 1834 (289–348).

from the King of Great Britain. Another account with light personal touches, and a narrative of Gerard's return journey, was published by Mohan Lal in Calcutta. With Burnes' *Travels* was published a map of Central Asia and a geographical memoir of which Sir Henry Yule remarks ;

> The amount of material collected by Elphinstone and Macartney during the Peshawar mission in 1809 was very large [II, 270–1], but greatly needed to be bound together by actual travel and survey. Still it added much new detail, and that of Macartney is..., *on certain points*, truer than later ones [244 n.1]. ...
>
> The memorable journey of Alexander Burnes...formed an era in Central Asian geography. Apart from the singular charm of his narrative, he for the first time afforded a chain of observations tying together the Indus, the Oxus, Bokhara, and the frontier of Persia, which formed the chief basis of Mr. John Arrowsmith's long unrivalled map of Central Asia, originally published as an accompaniment to Burnes' work[1].

Burnes himself writes ;

> With the assistance of Mr. John Arrowsmith...the materials of my survey have been incorporated with the latest geographical information. This will greatly enhance the value of the maps, which have been drawn by Mr. Arrowsmith himself, and carefully engraved.

He included a list of 34 places of which he had himself determined the latitude ;

> The instruments used were a sextant of nine inches radius by Gilbert, and the patent surveying compass of Schmalcalder [243]. ... With the sextant the parallels of latitude were determined, when practicable, either by a meridian altitude of the sun, or the elevation of the pole-star. With the compass the bearings...were observed. The time of travelling was noted on the spot from a valuable chronometer watch by Arnold.
>
> The rate of marching, after various trials by astronomical observation, was found to be...
>
> 1st. On horseback over a level country, ... without a caravan, ... 3¾ miles per hour.
>
> 2nd. On horseback over a broken or mountainous country, ... and accompanied by mules lightly laden, 3 miles per hour.
>
> 3rd. On camels over a flat country, ... 2 miles 300 yards per hour ; protracting...the great inflections of the road, and correcting them by peaks or notable landmarks in front or rear. ...
>
> That the rates...approximate closely to the truth is undeniably established by my protraction to the city of Bokhara, which fell within 30 miles west of the meridian of 64° 55′ east, ... the position assigned to it by the Russian mission [II, 271][2].

Of the political results of the mission Davis writes [III, 487] ;

> It was first and foremost a geographical survey, the aim being to discover what route would probably be followed by a Russian army advancing from the east side of the Caspian.
>
> Burnes ascertained that the Oxus was navigable from the head of its delta up to a point not more than twenty miles distant from the great barrier of mountains which separates Afghanistan from the plains of Turkistan. But he was impressed by the difficulties and dangers of the long corridor of passes which he traversed on his way through that barrier ; and his report on this stage of his journey shews that he had begun to doubt the probability of a Russian advance by...the Koh-i-Baba[3]. It seemed to him quite likely that the Russian army, when it came, would mount still higher up the Oxus, and then strike towards Kashmir where supplies would be abundant, and preparations for the attack on India could be made in full security. He indicated that Chitral was one of the key positions on this route. ...
>
> He established one conclusion which was of some practical importance. Travelling over a section of the route which leads from Bokhara to Merv and to Herat, he found nothing but waterless, barren, uninhabited desert, and the tracks so sandy that even if cattle were available, guns and heavy transport could only be pushed forward with the utmost difficulty[4] [pl. 16].

TRANSFRONTIER EXPLORATION ; JOHN WOOD, 1836–8

In 1836 Burnes was appointed commercial agent at Kābul, and given a staff of men like-minded with himself—Robert Leech of Bombay Engineers—John Wood of the Indian Navy—and Dr. Percival Lord of the Bombay medical service[5].

With Leech and Wood, Burnes reached Hyderābād, Sind, on 18th January 1837, and travelled up the river by boat, being joined by Lord at Rohri [244].

[1] Wood (xliv–v). [2] *Bokhara*, II (147–8) ; III (127). [3] 16,874 ft., 45 m. w. of Kābul. [4] Davis (24–5). [5] Percival Barton Lord (1808–1840 ; *DNB.*) ; kd. at Parwān Pass N. of Kābul, 2–11–40 ; *JRGS.* XII, 1842, (xxxviii) ob. notice.

Wood was commissioned to make a detailed survey of the Indus with a view to its being opened to regular steam navigation, whilst the others collected information of military and political interest, often travelling by land for the purpose.

Wood reached Mithankot 29th April and Dera Ismail Khān on 2nd June, fixing the height of Takht-i-Sulaimān as 10,086 feet above the river, and 11,000 above the sea [II, 65][1]. At Kalabāgh it was found impossible at that time of the year to travel up river by boat to Attock (about 100 miles), so Burnes and the rest of the party travelled by land on the left bank through Sikh country, leaving Wood to make what attempt he could by river.

> Captain Burnes was detained here some time by the difficulty of procuring bullocks to convey his party by land. As soon as he had obtained them he crossed to the Indian side of the river, and, under a Seik escort, left Kalabagh about the 22nd of July.
>
> My instructions were to make the best of my way to Attock by the river, or...to hasten there by land and thence descend by stream. I...made choice of the...fittest boat the place afforded, and commenced beating up for a crew to man her. ... At length thirty-seven men were obtained under an express stipulation that they were not to go higher than Mukkud, a town only twenty miles above Kalabagh, and on the 20th of July we commenced the ascent[2].

At Mukkud he had to abandon the attempt, and then made the land journey to Attock, arriving on 4th August, the day before Burnes' party. Taking boat on 5th, he reached Kālabāgh the next day "a little after noon, having averaged...six and three quarters miles an hour" downstream. On his return march he left Kālabāgh on 8th and reached Kohāt on 11th. He visited the sulphur mines and naphtha springs nine miles from Khushālghur, and arrived at Peshāwar on 19th.

> The day succeeding...my arrival at Peshawar I started for the Kabul river...descending it to Attock, ... to take another set of chronometric observations to determine its longitude. ... On the 21st I reached Attock, much pleased with the scenery on the banks of the Kabul river. The following day was devoted to...observations, and on the succeeding one I rejoined the mission at Peshawar. ... On the 28th of August the mission moved forward to Jamrud. ... A days were spent few here in negotiating with the Kyberies for the passage of this defile. ... On the 2nd of September we took a friendly leave of the Seiks [281 [[3].

Whilst Leech now surveyed the Khyber Pass[4], Wood followed the Kābul River. From Jalālābād he surveyed the south, or Karkatcha road, rejoining the main party to enter Kābul together on 20th September. He has left the following notes on his survey ;

> The position of the halting places having first been astronomically ascertained, these fixed points were...connected by...protraction of the road between them. The parallels of latitude were determined by the usual methods, and the longitude is a mean of two chronometers.
>
> To shew the drainage of the Sufaid Koh and the character of this portion of the valley of the Cabul River, it was necessary to follow up the rivulets of the former to the roots of the snowy chain. In doing this I have made use of native information. ...
>
> As the route between Peshawar and Cabool has been of late years traversed by different European travellers, the more marked features...have already been relatively laid down with great accuracy. But with regard to their true position on the earth's surface there is still considerable error. In the latest map...constructed from the route of the late Dr. Gerard in 1833 [276] the valley of the Cabool River is placed ten miles too high.
>
> Along the valley of the Cabool River the Himalayas overhang it to the north, and the Safaid Koh to the south. These ranges are nearly equidistant from the Cabool River, and their distance apart, viz., seventy miles, gives the width of the river basin.
>
> The mean elevation of the summits of the former chain is 20,248 feet above the sea, and the peaks of the latter...rise to the height of 14,100 feet, clad in as pure a mantle as their northern neighbours. These heights were obtained by measuring the distance of the peaks and the angles they subtended with the horizon, a method so influenced by the state of the atmosphere...that the results...can only be...approximation to truth[5].

Burnes records that

> we set out from Peshawar to Cabul in September last, and passed through the grand defile of

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[1] true height. 11,085 above sea ; Chart of Indus R., from Mittun to Attock, 1838, Wood, 5 sheets, 2 geo. m. to inch, taken on return journey with remarks on navgn., soundings, banks, etc., *IO Cat.* (137) ; MRIO. 114 (4–7). [2] Wood (66). [3] Peshāwar occupied by Sikhs 1834 ; Wood (86–8). [4] Svy. of Kabul R. from its mouth to *Mutchnee* by Nock, asst. to Leech, *IO Cat.* (478). [5] *Geographical Notice of the South side of the Cabool River*, Kabul, 31-10-37 ; *Reports & Papers*, Political, Geographical & Commercial, Calcutta, 1839.

> Khyber, which Lieut. Leech has minutely delineated, while Lieut. Wood has given a map of, and a paper on, the valley of the river of Cabul. In October we all proceeded to Koh-i -Damun, and Lord and Leech ascended the great pass of Hindu Kush to its summit[1].

The mission was warmly welcomed by Dost Muhammad, who gave them full liberty to pursue their geographical enquiries. "One of the objects", writes Wood, "which Captain Burnes had greatly at heart was...an entirely new map of Afghanistan, in which actual survey should supersede hearsay information".

In December, Leech was sent to Kandahār where he remained till May 1838 when he left Afghānistān for Sind, surveying the route over the Khwaja Amrān into Baluchistān, and down the Bolān Pass to Shikarpur on the road to Sukkur.

Whilst Lord and Wood were exploring the Koh-i-Damān, a few miles north of Kābul, an unexpected opportunity came for a visit to the country north of the Hindu Kush. A message came from Murad Beg of Kunduz [iii, 486 ; iv, 275] asking that the English doctor should come to treat his brother, who "had long been a martyr to ophthalmia". Wood and Lord were called in and set out together for the mountains[2].

They left Kābul on 3rd November intending to cross the Parwān Pass through the Koh-i-Damān rather than follow the better known Hajigak Pass to the west that led past the colossal image sat Bamiān. Everything went wrong. They fell into bad weather, were misdirected, lost the way, and had to return. On the 14th they set out again and this time "followed the direct kafila route" crossing the Hajigak Pass, "geographically remarkable as dividing the waters of the Afghan country from those of Turkistan" [pl. 16]. They reached Kunduz on 4th December, and Lord took charge of his patient with little hope of success. After a week, writes Wood,

> as there was every probability of our being compelled to remain the winter, the question arose how we could most profitably employ this sojourn. ... The great object of my thoughts by day, and dreams by night, had for some time past been the discovery of the source of the river Oxus and, thanks to my fellow traveller's tact, ... Murad Beg on the 10th of December conceded his permission to me to trace the Jihun, an appellation by which this river is better known among the Uzbeks. ...
>
> Murad Beg is but at the head of an organized banditti, a nation of plunderers, whom, however, none of the neighbouring powers can exterminate.

Leaving Lord in Kunduz, Wood set out on 11th December 1837. Held up by winter weather at Jurm, the capital of Badakshān, for over a month, he took the opportunity to visit the ruby mines near by, and to map the neighbourhood. Early in February he started on his final stage ;

> Proceeding up the valley of the Oxus, with the mountains of Shakh Duran on our left, ... and those of Chitral on our right, both rising to a vast height[3], ... we...entered Wakhan. ...
>
> The first yaks we saw were grazing among the snow on the very summit of the rugged pass of Ish-Kashm, and...I procured one for Dr. Lord, and despatched it to Kunduz in charge of two trusty men. But so cold a climate do these singular animals require that, though winter still reigned in the Kunduz plain, the heat was too great, and the yak died within a march or two of the town. ...
>
> The valley of the Oxus may be said to terminate at Issar, The latitude of Issar is 37° 02′ 10″ N., and its height above the sea 10,000 [feet]. Here the main valley divides into two, ... the former...into Chitral, and the latter across the table-land of Pamir to Yarkhand. ... One of them, it was certain, must lead to the source of the Oxus.
>
> Among the rivulets [to the south] is Pir-khar, a name of note in the geography of these regions, since Macartney [ii, 270–1 ; iv, 277], with his usual discernment, had supposed it to be the fountain head of the Oxus, and we see how closely he approximated to the truth. Indeed, none but those who have travelled in the countries he mapped, almost entirely from native information, can duly appreciate the labours of that talented...officer [244 n.1].

They climbed high into the mountains ;

> We mounted sturdy hill poneys and...struck into the Siri-kol. ... Halting place was 12,000 feet above the sea. Next night's halt 13,500 feet, ... travelling over snow and ice. Every step the snow lay deeper and deeper, and, near as we had now approached to the source of the

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[1] *Bo Geo Trans.*, ii (72), 26–5–38. [2] Report by Lord, *JASB.*, vii, 1838 (521–37). [3] Tirich Mir, Chitrāl, 25,263 ft.

> Oxus, we should not have succeeded in reaching it had not the river been frozen. We were fully two hours in forcing our way through a field of snow not five hundred yards in extent. ...
>
> In the afternoon of the 19th February 1838, we stood, to use a native expression, upon the Bam-i-Duniah, or Root of the World, whilst before us lay stretched a noble but frozen sheet of water, from whose western end issued the infant river of the Oxus [pl. 16].
>
> This fine lake lies in the form of a crescent, about fourteen miles long from east to west by an average breadth of one mile. On three sides it is bordered by swelling hills about 500 feet high, ... whilst along this southern bank they rise into mountains 3,500 feet above the lake, or 19,000 above the sea, and covered with perpetual snow. . .
>
> Western end, latitude 37° 27′ N. by meridian altitude of the sun, and longitude 73° 40′ E. by protraction from Langer Kish where the last set of chronometer observations had been obtained. Its elevation measured by the temperature of boiling water is 15,600 feet, as my thermometer marked 184° of Farhenheit. ...
>
> I was much tempted to apply the name of Victoria[1] to this...newly re-discovered lake, but, on considering that by thus introducing a new name, however honoured, into our maps, great confusion might arise, I deemed it better to retain the name of Sir-i-kol...given...by our guides. The description of this spot given by the good old traveller Marco Polo [I : 70 ; pl. 16], nearly six centuries ago, is correct in all its leading points.
>
> As early in the morning of Tuesday the 20th February as the cold permitted, we walked out about 600 yards upon the lake. ... The sounding lead, ... much to my surprise and disappointment, ... struck bottom at nine feet, and we had...brought with us...a hundred fathoms of line for the experiment[2].

On modern Survey of India maps the lake appears as Zor Kul (Lake Victoria), at latitude 37° 23′ N., longitude 73° 40′ E[3].

Wood had an uneventful journey back to Kunduz where he rejoined Lord on 11th March, after exactly three months absence. During the next month he mapped the country north to the Oxus, whilst Lord visited Mazar-i-Sharif where the last of Moorcroft's party had died thirteen years before ;

> With the aid of the...superintendent of the shrine, he succeeded in getting possession of every book...belonging to the party, even to the daily cash account book. But among them were no manuscript details of their journey, and it is now pretty certain that none existed independent of those from which Professor Wilson compiled his late work [III, 487][4].

They left Kunduz on 12th April and travelling by the Khawak Pass, 13,200 feet[5], reached Kābul on 1st May, to find that Burnes, owing to a change in the political situation, had already left on 26th April, leaving them orders to follow.

> Before finally quitting Kābul we waited on its ruler. ... Dost Mohamed Khan was engaged at chess when we entered. ... His manner was at first cold ; ... he soon assumed his usual tone of cordiality...and he bade us a kind farewell. From Kabul we marched to Jalalabad. ... From Jalalabad we embarked on rafts of inflated skins and dropped down with the stream to Peshawar. Here we rejoined Captain Burnes, now ordered to Lahore[6].

Under the new official policy Dost Muhammad was declared an enemy, and preparations were put in hand for the invasion of Afghānistān. Though the mission led by Burnes had not been initiated for military purposes[7], the Quartermaster General in September 1838 welcomed

> full...surveys of the Hindoo Koosh, the Kyber Pass, and all the country between Cabool and Heraut. The surveyors with Captain Burnes have put us in possession of much valuable knowledge, ... and Lieut. Leech...is now on his way down from Kandahar to Shikarpoor, while Lieut. Wood is making a survey from Peshawar to Mithankot [278 n.1, 283 n.7].
>
> The whole of the passes through the Hindoo Koosh are now as thoroughly known as the passes of Kheree and Timlee leading to the Deyra Dhoon [pls. 16, 17]. The Boolan Pass by which the army advances from Shikarpoor towards Kandahar has also been examined[8].

Wood published an account of his travels in 1841 under the title of "*A personal Narrative of a journey to the source of the River Oxus*, by...the Indus, Cabul, and Badakshan, ... in the years 1836–37–38"[9]. Facing p. xc. is a map of the Oxus, and facing p. 280 is another stretching from the mouths of the Indus to the Pamirs[10].

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[1] Queen Victoria came to throne 8 months before. [2] Wood (139–236); cf. *JRGS*. X, 1841 (530–6). [3] on map, Wood (xc), name appears Victoria or Sikandari ; on map, Wood (280), Sir-i-Kol. [4] Wood (267). [5] Wood's survey, MRIO. 112 (79). [6] Wood (279). [7] *Imp Gaz*. II (13). [8] to Lawrence, Edwards (125) ; Sketch of passes, Holdich (500). [9] *Cal. Rev.*, I (449). [10] Wood's maps, MRIO. 116 (31) ; 112 (79).

A 2nd edition was issued in 1872[1], with a biography by his son Alexander Wood, and an *Essay on the Geography of the Valley of the Oxus* by Henry Yule.

The full reports on Burnes' mission, political, commercial, and geographical, are contained in *Reports and Papers, Scinde, Afghanistan, and adjacent countries*, published in Calcutta, 1839 [278 n.5].

AFGHĀN WARS, 1838–42

The so-called forward policy on the north-west frontier which eventually led to the disastrous campaigns in Afghānistān of 1838–9 and 1841–2, had been in ascendancy from about 1831 or thereabouts. One of its foremost advocates was Claude Wade, in political charge at Ludhiāna, and one of its most notable figures was Alexander Burnes. The two Afghān protagonists were Shāh Shujah, who had been in exile in India after treating with Elphistone at Peshāwar in 1809 [II, 65–6], and Dost Muhammad, the generally popular ruler at Kābul[2].

Advised by Wade, the Government of India in 1833 aided Shāh Shujah in an invasion of Afghānistān which resulted in his defeat near Kandahār on 30th June 1834. With Shāh Shujah's connivance, Ranjīt Singh, "the Lion of the Punjab", took the opportunity to sieze the Afghān province of Peshāwar. Dost Muhammad now made friendly overtures to the British, hoping for their aid in recovering Peshāwar. He later welcomed the appointment of Burnes as commercial agent at Kābul. In 1838, Dost Muhammad's reception of envoys from Russia, and a mistaken faith in Shāh Shujah, led Lord Auckland[3] to restore Shāh Shujah to the throne, and to conclude a tripartite treaty with him and the Sikhs to that end[4].

Lord Auckland's policy was to have a reliable friendly Afghānistān as buffer against a possible aggressor beyond. "Preparations for war are going on", writes Fanny Parks, "fifteen thousand men from Bengal are to march on Cabul, and defend that part of India in case of an attack from Russia and Persia"[5].

To avoid the passage of so large a force through Sikh territory, the British "Army of the Indus" was assembled at Sukkur, thereby infringing the treaty with Sind [244], and with great difficulty marched up through the Bolān Pass to Quetta, and over the Khojak to Kandahār. After the historic storming of Ghazni, at which George Thomson and Henry Durand particularly distinguished themselves[6], the army reached Kābul on 7th August 1839, and Shāh Shujah was installed as ruler over a reluctant country, with William Macnaghten as British Envoy, Burnes as commercial agent, and a British garrison.

Dost Muhammad fled over the Hindu Kūsh, but surrendered in 1840 and was sent to India. In November 1841 the Afghāns rose against the force of occupation. A few prisoners taken were rescued later but Shāh Shujah, Macnaghten and Burnes were killed, and the force which on 6th January 1842 marched out from Kābul 16,000 strong was utterly destroyed, except for the solitary survivor who rode in alone to Jalālābād. The garrisons at Jalālābād, Kandahār, and the little fort of Kalāt-i-Ghilzai, survived to be relieved by Pollock's army[7], which marched up from Peshāwar and occupied Kābul on 15th September 1842. Joined by Nott's force from Kandahār[8], Pollock then withdrew on 12th October for the return march.

After the appalling results of this interference in the affairs of a friendly neighbour, Lord Auckland was recalled. Wade was appointed Resident at Indore[9].

Throughout the campaign there was a steady output of sketches and routes from officers of every corps and of every degree of competence. With the Army of the Indus which marched from Ferozepore on the Sutlej on 10th November 1838 John

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[1] All page refs. to 2nd edn. [2] For clear account of Afghān history 1810–39 ; *v.* Vigne, I (v–xxxviii) and *Imp Gaz.*, II (500–2). [3] Geo. Eden, 1st Earl (1784–1849) ; GG. 1835–41 ; *DNB.* ; *DIB.* [4] Lahore, 26–6–38. [5] Fanny Parks, II (254). [6] 23rd July 1839 ; plans & sections of Ghazni by Durand, MRIO. Misc. 4–0–39 Sandes I. (271–4). [7] Sir Geo. Pollock (1786–1872) ; Ben Art., founder of Pollock medal, RMA. ; FM. 1870 ; Bart. 1872 ; *DNB.* [8] Sir Wm. Nott (1782–1845) ; Ben. Inf. *DNB.* [9] *Imp Gaz., Afghānistān* (13) ; Sandes, I (267–79) ; Davis (26–31).

Anderson and Henry Durand had been appointed official surveyors[1]. Durand reports in his memoir of 1st August 1840 [294];

> The longitude of the starting point, viz., Ferozepoore, has been deduced by means of a route survey from...Delhi and Kurnaul. ...
>
> The route survey was, with the exceptions to be hereafter noticed, carried on by Lieutenant Anderson and myself. ... Latitudes of a great part of the halting places were ascertained, either by meridian observations of the sun or of the stars.
>
> The longitude of Sukkur was obtained from...meridional transits of the moon and of moon-culminating stars. ... Two of those petty accidents unavoidable in a military camp threw the transit instrument out of adjustment, ... and valuable opportunities were thus lost. In consequence of these very mortifying accidents, the observations obtained before the breaking up of the sapper camp from Sukkur were neither so good nor so numerous as we wished. Their mean gives the longitude of Sukkur at 68° 52′ 32″[2].
>
> The latitude and departure for each day's survey having been calculated, the result tallied with the differences of position ascribed by observations to Sukkur and Ferozepoor more closely than could have been anticipated[3].
>
> The longitude of Candahar we also fixed by means of meridional transits. ... We...prefer their mean to the longitude derived from...nine observations of eclipses of Jupiter's satellites. ... The latitude of Candahar as given is the mean of 43 observations of stars on the meridian[4].
>
> The longitude of Caubul could not, in consequence of an accident to the transit instrument, be determined by lunar stellar transits, nor were eclipses of Jupiter's satellites then visible. ...
>
> Lieutenant Anderson was sick the greater part of the time that the Force was at Caubul, and Lieut. Sturt, who for a month relieved me in the duties of Surveyor, was...surveying the route to Bameean [279][5]. My own occupations as Engineer to Shah Shooja-ool-Moolk...prevented me during that month from prosecuting...the survey, and when relieved by Lieutenant Sturt...the immediate march of the detachment towards Hindostan precluded any further attempts at ascertaining the longitude of Caubul. It rests, therefore, for the present upon the mean of a few sets of lunar distances[6]. ...
>
> After his joining our camp at Shikarpoor, we...received the willing assistance of Mr. W. Griffith, and...besides the copy of a register of barometrical observations...we are further indebted to him for frequent aid in the observations of lunar distances, etc[7] [294, 446].
>
> The route from Quetta to Kelat and Gundawa was kindly furnished by Major Peat, Bombay Engineers [283 n.6], with an intimation that, in consequence of the perambulator having broken, due allowance must be made. ...
>
> With the exception of dotting in the return route of the Bombay Column...to the Pishun valley upon information also furnished by...Major Peat, and the course of the Punjab rivers from...the latest maps, ... nothing has been introduced into the map...which has not been actually surveyed. This gives...a mere skeleton...which would have been still more meagre had it not been for the survey by Lieutenant Broadfoot [283 n.6, 284][8].

The dates given by Durand in this journal are—Ferozepore, November 1838—Bahāwalpur, 21st December—Bolān Pass, 20th March 1839[9]—Kandahār, 12th June—Ghazni, 25th to 29th June—Kābul 10th August to 2nd October—Peshāwar, 7th to 17th November—Jhelum, 12th December—Lahore, 26th December.

Other Bengal officers who contributed surveys during the advance or the subsequent occupation included Edward Sanders, who surveyed the route of the "British mission from Candahar to Herat in June and July 1839"[10] [283–4],

> with the assistance of Lieut. North of the Bombay Engineers. Several of the marches were made by night but, altho' this...has prevented the map being made so full as could be wished, ... a tolerably accurate route survey.
>
> My determination of the...S.E. angles of the city of Kandahar is N. latitude 31° 36′ 30″. ... The longitude I make...65° 30′, but in this result I have not much confidence, the observations having been taken without assistance, and the computations hurriedly made. ...
>
> The latitude of the centre of the city of Herat is 34° 29′ 20″ North. The longitude...by stars 62° 7′ E.; I hope...that it does not differ 5 miles from the truth[11].

---

[1] GBO. Lib. E. (7) MRIO. 12 (10); map of route Army of Indus, 10 m. to inch Memoir, M 52. [2] true value, 68° 52′ 52″. [3] Plan of Roree, Sukkur & Bukkur, survd. by Anderson & Durand, drawn by Lt. A. Broome, Ben. Art., 1839. [4] also fixed by Edw. Sanders. [5] MRIO. 114 (4), Defences of Bala Hissar, Kabul, 12-12-39; J. L. D. Sturt. [6] Fdbk. M 554 gives mean lat. Kābul 34° 30′ 15″; true value 34° 31′; [I : 148 n.2]. [7] *IO Cat.* (479); MRIO. 113 (8), Koonar R. from Chuggar Serai to Besood, Wm. Griffith, 1840, NE. from Jalālābād. [8] ib. 12 (10). [9] MRIO. 112 (8), Bolān Pass, Dadur to Quetta, Durand. [10] MRIO. 116 (33). [11] Sanders to DSO., Herāt, 16-7-40; DDn. 390 (99).

Herāt had first been visited in 1810 by Charles Christie [II, 385], and later by Arthur Conolly, who had left England in August 1829, and

> in 1830 rode from Tabriz [in the Caucasus] to Herat, then visited Kandahar, and returned to India by the Bolan Pass. ... This was in some stages a perilous journey [293].
>
> At the outset Conolly made for Khiva, to find out whether that State was in serious danger of being invaded by the Russians; but he was kidnapped and held to ransom in the desert. The ride to Herat was safe and easy; he carried credentials from the British minister at Tehran...and was thought to be a diplomatic agent.
>
> In Kandahar, however, he had to conceal his identity because the rulers...had been warned of the advent of an English spy. ... He owed much to the courage and presence of a Mohammedan of Indian extraction, who nursed him when he was sick at Kandahar, and supplemented Conolly's own work in collecting information[1].

Conolly lost his life in June 1842 whilst on a mission to Turkistān.

In July 1837 the Persians marched eastward intent on the invasion of Afghānistān and India [281], but were held up from November 1837 to September 1838 in a vain attempt to capture Herāt, in the defence of which Eldred Pottinger[2] distinguished himself. In 1839 Pottinger marched from Herāt to Kohistān, north of Kābul, and later compiled a rough sketch of northern Afghānistān prepared mostly

> from native information. It rests on routes marked in red and blue separately. That marked red—Herat-Siripul-Bameean-Kabul, also Herat to Sirisuk—was travelled in the end of 1839 by Dr. Richie, of the Medical Establishment of Bombay, and myself. The part between Herat and Kila Now was surveyed by Captain E. Sanders of the Bengal Engineer Corps. That from Kila Now to Zerguh in Koochu by myself with the aid of Dr. Richie and, I being there disabled by an accident, the remainder of the route was surveyed by Dr. Richie alone. ...
>
> The route marked blue—Herat, due north—was followed by Capts. Abbott & Shakespeare, of the Bengal Artillery, in going to Khiva[3].

Abbott's journey, with Shakespeare's route to the Caspian, is described in Abbott's published narrative *Heraut to Khiva*[4], and appears in a "protraction from Lt. Shakespeare's route from Herat to...Alexandrosky on the Caspian Sea, 1841, scale 36 miles to an inch"[5].

"A Map of Afghanistan and part of Baluchistan" that was compiled in 1840, scale 8 miles to an inch, at the Surveyor General's office, bears acknowledgment to the following surveys besides those used for the map of Sind [246];

> Route marched by the Indus in 1839, from Baugh, via Kandahar, Ghazni, Cabul, and Peshawar to Attock, by Major W. Garden, DQMG. Bengal Army, scale 1 inch to 4 miles[6].
>
> Chart of the Indus River from Mittun Kot to Attock, by Lt. John Wood, Indian Navy, 1838, scale 1 inch to 2 [geogl.] miles[7].
>
> Route of the British Mission...Kandahar to Heerat, 1839, Capt. E. Sanders...and Lieut. North [284]. ...
>
> Map of Seistan and some of the neighbouring countries, by Lt. Edward Conolly and Sergeant J. Cameron, 1839, ... 1 inch to 4 miles. ... [282].
>
> Capt. Wade's routes in his different missions to the Punjab, surveyed by Mr. Nathaniel Hodges, Sub-Assistant Revenue Surveyor, in 1838; 1 inch to 4 miles [273].
>
> A rough map of Paropamisan, compiled and elaborated by Major Eldred Pottinger...1839, based on surveys by Dr. Richie. ... Protracted in the Surveyor General's Office, Calcutta [*sup*]. ...
>
> Sketch of part of Upper Sind, by Lt. Jacob, Bombay Artillery, 1 inch to 2 2/3rd miles [246].

Several maps by officers of the Quartermaster General's department, Bengal, are countersigned by William Garden, D.Q.M.G.—John Paton, Girishk, Kandahār, Kābul, 1839—Arthur Becher, Ghazni and surrounding country[8]. There is a "Survey and route from Jummait in the Ghilzai country to Pishin valley, via Lewa Tunga Pass", by Lt. Creed, Bombay Artillery, 1840[9].

In an account of a map of "The Basin of the Helmund"[10] which he compiled after the war, William Fraser-Tytler describes several surveys of which little or no reference has been found elsewhere. In December 1838 he had

> received orders to proceed to Afghanistan with the Army of the Indus as assistant in the department of Col. Garden, the D.Q.M.G. He remained in the country till December 1842. He devoted the whole of his spare time to the collection of geographical information[11].

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[1] Davis (19–40). [2] nephew of Henry Pottinger [II, 437–8]. [3] *IO Cat.* (472); 10 Maps (38); Heraut to Khiva & St. Petersburgh, James Abbott; MRIO. iii (4) includes Pottinger's "rough sketch". [4] reviewed *JRGS.* 1844 (li). [5] MRIO. 115 (16); *IO Cat.* (472–3). [6] includes Sturt's survey Kābul to Bamian; Broadfoot, Ghazni to D.I. Khān & Peat, Quetta to Kalāt. *IO Cat.* (478); in 2 large sheets; MRIO. Misc. 11–O–39. [7] Surveyed. on downward journey from Attock after May 1838 [278 n.1]. [8] MRIO. 112 (23, 36–41, 46–7, 71): Misc. 8–O–39; 7–O–39, sketch of Ali Masjid, Geo. Thomson. [9] MRIO. 116 (24). [10] *IO Cat.* (480–1). [11] surveys of Kunār valley, MRIO. 113 (5–7).

He records that

> Edward Conolly—brother of the...officer who was afterwards murdered at Bokhara [283]—accompanied by Sergeant Cameron, ... made an adventurous journey in 1839 from Persia to India by Herat and Sistan Lake, which he was the first to describe with any precision in his Sketch of the Physical Geography of Sistan[1][pl. 16]. ...
>
> Conolly's surveying work was executed by Sergeant Cameron (who was afterwards murdered in the Khaibar Pass) except the route across the desert from Sistan to Kala Bisht on the Helmund, which Captain Conolly himself sketched as his companion was struck down with fever. ... Conolly's map was published at the time[2], and reproduced in the Quartermaster General's office at Simla in 1872, scale 8 miles to an inch.

Fraser-Tytler himself made "a careful and detailed survey of the valley of Kandahar", and reconnoitred the Arghandab and Helmand valleys to the west, that were also skirted by Sanders and North [282]. The Bugran, a tributary of the Helmand, was surveyed by Cooper, and Pattenson was sent down the Helmand to connect with Christie's route at Pullaluk [II, 385]. He "was soon afterwards murdered by some mutinous troops at Kandahar".

> The country to the east, especially the Guwal valley and the region of lake Abistadeh, was surveyed by Lieut. Broadfoot and partly by the Bombay force. .. The valuable work of Lieut. Sturt from Kabul to Bamian was unfortunately lost [283 n.6][3].

Much survey was also carried out by officers of the Bombay army [246][4], principally under the direction of Neil Campbell, Q.M.G., whose signature is often the only one appearing. Most of these were embodied in the S.G.O. maps of 1840 and 1841 [246, 283], others being—

> A Survey of the entrances of the Passes on the Jhalwan frontier between the Moola and Bolan Passes with a part of northern Cutchee, to which is added a survey of the Bolan Pass to Quetta, Mustang Nushki, etc., surveyed by G. Le Messurier[5].
>
> A Survey of the two direct routes through the Jhallawan States of Baluchistan, leading from Kelatok, to Somniani (near Karachi) by Major Le Messurier and Lt. Robertson[6].
>
> Survey of Sind, part of Baluchistan and Afghanistan, principally by Q.M.G.'s Department, and showing the routes marched by the Bombay Division of the Army of the Indus, from the mouth of the Indus to Kabul and Kalabagh, and Kabul to Peshawar, 1 inch to 16 miles ; 1841.
>
> Survey by Q.M.G.'s Department through Sind, Baluchistan, Khorosan, to Kandahar ; Karachi to Tatta, Hyderabad, Sehwan, Larkana, Dadur, Kandahar, ... 28th June 1839[7].
>
> Survey around Cabul, including the Koh-i-Damun [279], and part of the Loghur districts[8].
>
> Route from Dera Ghazee Khan to Kandahar, Sketches and views of Bolan Pass, near Kusteree, 1839-40.

None of these surveyors working on and beyond the north-west frontier belonged to the Surveyor General's department [I, 10].

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[1] *JASB.* IX (710). [2] MRIO. 113 (44-50). [3] Route Ghilzai to Kābul, Fraser Tytler, MRIO. 116 (30); Kandahār, ib. Misc. 3, 10-0-39. [4] *Geo Mag.* I, 1874 (1-4). [5] MRIO. 113 (33). [6] *IO Cat.* (479); MRIO. 116 (34), with notes on copper, antimony, and lead, and barometrical section. [7] MRIO. 111 (43); 112 (3, 5, 7, 18, 48); 113 (39); 10 Maps, UV. iv 12 ; *v.* 3 ; *vi* ; *IO Cat.* (136-7), LV. 4. [8] ib. 112 (1-7).

Plate 16

AFGHĀNISTAN & THE NORTH WEST

Reproduced from map, scale 65 m. to inch, compiled in Q.M.G.'s office, Calcutta, to accompany Report on Central Asia dated 1869.

Compiled largely from military surveys made during Afghan Wars 1839-42, and explorations of Burnes, James Gerard, and John Wood, 1832-8 [ch. xvi].

CHAPTER XVII

MAPS: BENGAL PRESIDENCY

Bengal Districts — Maps from Revenue Surveys — Himālayan Areas — Quartermaster-General's Department — Afghānistān & the North-West — Calcutta Drawing Office — Survey Committee, Calcutta, 1837–41.

IN spite of the continued efforts of Colebrooke and Hodgson, there were in 1830 no maps of the Bengal Presidency that could supersede Rennell's manuscript 5-mile —or published 12-mile—maps, which were both sadly inadequate and almost unobtainable [I: 226; IV, 261–2]. The new quarter-inch Atlas could not be compiled until the results of the Great Trigonometrical Survey became available.

The Directors asked that district officers should be provided with maps of their districts, and that a map should be sent home shewing all district boundaries [III, 276]. Everest found this difficult ;

> The map...shewing the boundaries of all the districts shall be prepared with the least practicable delay, and the district maps for the Collectors and judicial authorities...commenced upon.
>
> But as no documents...are forthcoming exhibiting the present boundaries...(Rennell's Atlas delineating only the old boundaries), ... circular letters [may] be sent...to the several... authorities to furnish...a list of villages in each purgunnah, and the number of purgunnahs... in each district, ... with such...observations...as may enable me to have the maps constructed[1].

The Revenue Department pointed out that

> as many districts contain 2 or 3,000 villages, ... the information...would be so voluminous as to be unmanageable. Besides which, in the permanently settled provinces at least, it is doubtful whether the information could be given with any accuracy.
>
> The following may perhaps be found a more practicable...plan. There are 21 Divisions [287]. ... Of each Division a map may be constructed with lithographic ink on transfer paper, ... 8 or 10 miles to an inch. In the map may be entered...the cities, towns, villages, etc., and the general features...such as rivers, lakes, mountains, etc., but not the local divisions or boundaries of purgunnahs, thannahs, zillahs, etc.
>
> Nine or ten copies of each...may be prepared by the lithographic process, and the stones bearing the impression be preserved. One copy may be sent to each public officer in a Division, ... to mark...the stations of police or revenue officers, and to trace...the boundary, not only of the zillah, but also of each subordinate police and revenue Division.
>
> The maps thus filled up may be compared and corrected in your office, and the details inserted on the lithographic stones. ... The completed maps may then be struck off. ... From these materials the map required...may be easily and accurately prepared. ...
>
> You are also requested to prepare for...this office...maps of the province of Arrakan and of the Saugor and Nerbudda Territories[2].

Everest accepted this procedure, recommending the 8-mile scale ;

> As the Saugor and Nerbudda Territories form a tract...quite detached from the revenue provinces, I have ordered a map...to be prepared, but the province of Arrakan being included in the 16th, or Chittagong, Division, it will be incorporated in the map of that Division[3].

From 1820, whilst the Nāgpur Territories were administered by a British Resident on behalf of the infant Rāja, the Saugor and Narbada Territories[4] were ceded to the Company and placed under a Political Agent. They had not, therefore, come under survey by Norris [III, 90–3 ; pl. 24 ; IV, pls. 1, 3], and in 1830 William Sleeman, who was starting his campaign against the *thugs*, had complained that

> there is...no map of the...surrounding territories and...I shall labour under great disadvantages in attempting to intercept the gangs of dacoits...on their annual murderous excursions. ...

---

[1] DDn. 265 (227–9), 23–7–31. [2] DDn. 261 (58–63), 26–7–31. [3] BTC. 11–10–31 (21). [4] Saugor dists., Saugor, Damoh, Jubbulpore ; Narbada dists., Mandla, Seoni, Narainpur, Hoshangābād, Nimar, Betul.

> It would be to me of very great importance to have a skeleton map...north and south from Madras to Delhi, and east to west from Calcutta to Bombay, and containing all the principal rivers and lines of road, with all the principal stages at which travellers halt, and all...ferries at which they cross the rivers, together with all the seats of our civil and military establishments. ...
>
> Such a map...would enable me to direct with much more efficiency the operations... after these horrid murderers than I could otherwise do, for I shall be often liable to direct them upon a wrong road, and to lose time by doubts and mistakes[1].

District officers were very vague about the limits of their districts, and sorely worried by the lack of authentic records. Everest tells the magistrate of Bārāsat, in the 24-Parganas, that the only map of his area was one

> by Captains W. E. and Hugh Morrieson of...part of the Soonderbuns [II, 16–7]. ... But even this map exhibits 5 or 6 blank spaces, amounting to nearly one-fourth...of the whole district. No plans in this office exhibit the exact boundary of the Barraset District[2].

In 1837 the Indian Law Commissioners asked for

> a map of all the provinces under the Bengal Government, in which the districts under the jurisdiction of every zillah court may be coloured distinctly. ... The districts under...every Magistrate and Joint Magistrate may be shewn by black lines, and pergunnahs or other similar local divisions may be marked out by dotted lines. ...
>
> Rivers and navigable channels, great lines of road, the stations of all Courts, ... of daroghas of Police or other officers exercising the powers, ... the dependent outposts of police; towns and extensive villages, ... hills—large lakes...and jungles—should appear in this map. ... An estimate of the population of every town or large village...may...accompany the map. ... The population of every pergunnah or similar local division should be noted in the same statement, and...the number of villages estimated to contain less than 4,000 souls[3] [322].

This formidable demand reached De Penning at Calcutta, with a call for

> a copy of each of the best district maps for all the districts of the Lower Provinces, one for each district. When the particular boundaries of a district may not be marked in any map in your possession, a copy of the best map of the country...may be sent, in which the mofassil authorities will...mark off the boundaries to the best of their ability[4].

In 1833 Everest was anxious to help the Commissioner of Meerut[5] through whose Division he was laying out the Great Arc, and he directed De Penning to prepare a map of the Division on scale four miles to an inch;

> I wish this map to be done in the best possible style. ... I know there will be some difficulty about ascertaining the boundaries, but if you...will...tell me exactly...what is wanting, I shall perhaps, by means of the Superintendent of Revenue Surveys, be able to supply the deficiency[6].

The Collector of Ghāzipur was trying to collect a map of his district;

> The materials were all put into the hands of Mr. Osborne[7], a professional surveyor attached to the Opium Department, by whom they have been very neatly and correctly arranged but, unfortunately, owing to the refusal of Government to indemnify that gentleman, ... we have still to lament the want of a record of such universally acknowledged usefulness. ...
>
> Despairing of being able to raise by private subscription a sum sufficient to induce Mr. Osborne to undertake the publication of his map, I put myself in communication with Mr. Thomason, the Magistrate and Collector of Azimghur [223–4]. From that officer I learn...that he obtained a map of the District of Azimghur compiled at the Surveyor General's Office when he was appointed to his present charge[8].

The 8-mile maps promised by Everest [285] became available to the public in 1841, when Tassin published his "New and improved Map"

> of the provinces of Bengal and Behar, with Benares and adjoining territories, exhibiting the district divisions, the civil and military stations, and police thanas, and likewise the principal indigo, silk, and sugar works. Compiled from the most recent surveys, and best information in the possession of Government and private individuals, by J B. Tassin, 1841. Scale 8 miles to 1 inch [312]. Mounted on cloth and dissected; in four sheets[9].

Other maps were produced by Charles Joseph [III, 321 n.3; IV, 267];

> Map of the 13th, or Bauliah, Division, comprising the districts of Dinajpur, Rangpur, and Rajshahi, and the joint magistracies of Bogoora and Pabna. Compiled from Major Rennell's

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[1] to AGG., 18-11-30; DDn. 262 (64–6). [2] DDn. 266 (208), 29–9–32. [3] DDn. 296 (94–5), 23–6–37. [4] ib. (91–2), 27–7–37. [5] from Commr. 20–11–33; DDn. 82 (440). [6] ib. (441–2), 22–11–33. [7] Geo. Osborne, possibly related to Henry and Wm. [III, 493]. [8] DDn. 345 (19–21), 21–3–36. [9] *Imp Lib M & P* (398) 10 Maps, 1–AC. 17; *IO Cat.* (169); MRIO. 41 (27).

(1764 and 1772)—Captain Wilcox's (1830–31)—and Captain Fitzgerald's (1824–25)—surveys in Surveyor General's Office, in 1841. Scale 5 m. to inch[1].

Map of...country between Parasnath Hill and Juggurnath Pagoda, and extending 64 miles east and west of the Meridian of Purusnath. ... Scale 8 m. to inch. 1832[2].

It was not until the revenue surveys were well advanced that any satisfactory map of the district boundaries could be compiled. The 16-mile map of the North-Western Provinces of 1836 was the first to show them in a general way [pls. 3, 11][3].

The following were the revenue divisions and districts of 1833 [178][4];

Division Number	Sudder, or Hdqr. Station	Component Districts, or Zillahs
Delhi Territory	Delhi	Delhi—Panipat—Gurgaon—Hissar—Rohtak.
Saugor & Nerbudda Territories	Jubbulpore	Jubbulpore—Saugor—Seonee—Hatta—Rohlie—Hoshungabad—Narsingpoor—Baitool.
1.	Meerut	Meerut—Saharanpore—Moozaffarnagar—Bulandshahr—Dehra Dun.
2.	Agra	Agra—Aligarh—Muttra (Syabad).
3.	Furruckabad	Furruckabad—Mynpoory—Sirpoorah [Etah]—Etawah—Helah.
4.	Mooradabad	Mooradabad—Nagina [Bijnor]—Saheswan [Budaun].
5.	Bareilly	Bareilly—Shahjehanpore—Pillibheet—Kumaon.
6.	Allahabad	Allahabad—Futtehpore—Cawnpore.
7.	Hameerpore	Hameerpore or Calpee—Banda—(North & South Bundelkhand).
8.	Benares	Benares—Mirzapore—Jaunpore.
9.	Goruckpore	Goruckpore—Azimgarh—Ghazeepore.
10.	Sarun	Sarun—Shahabad—Tirhoot.
11.	Patna	Patna—Behar—Ramghur (now Hazaribagh).
12.	Monghyr	Bhaugulpore—Monghyr—Malda—Purnea.
13.	Bauleah	Dinagepore—Rungpore—Rahshahye—Buggoorah (Bogra).
14.	Moorshedabad	Moorshedabad—Beerbhoom—Nuddea.
15.	Dacca	Dacca—Dacca Jelalpore—Mymensing.
16.	Chittagong	Arracan—Chittagong—Bullooah [Noakhali]—Tipperah.
17.	Assam	Assam—N.E. Rungpore—Sheerpore—Sylhet.
18.	Allypore	Backergunge—Jessore—Suburbs of Calcutta—24-Pargannahs.
19.	Cuttack	Cuttack—Khoordah—Balasore—Midnapore—Hidgellee.
20.	Burdwan	Burdwan—Jungle Mehals—Hooghly.

The 8-mile maps of the Narbada territories were of little real value, and in 1840 the political officer at Jubbulpore contributed

> observations made by myself with a Troughton's reflecting circle while passing through portions of the Sagar and Jubbulpore districts. Equal altitudes of the sun...and meridian double altitudes of the sun or a star...having been taken at almost every halting place in my route, ... the time employed being a pocket chronometer. ... Six exceedingly rough sketches on country paper...[were] made by me on the same route with prismatic compass and tripod, in which no other measurement was effected than that assumable for the time employed by my horse in walking. ...
>
> [A] map...dated May 1834...was furnished by the Revenue Survey Department at Allahabad...on a scale of 8 miles to an inch, ... including the entire territory under this Agency. The diminutiveness of its scale would...render it of little service to a district officer.
>
> The parts of the large engraved map which are applicable to my requisition are Nos. 70 and 71 [pl. 23]. Nothing can be more admirable than that portion of the latter which represents the pargunnahs...below the ghats. ... Hatta, especially the part lying along the Sonar River, is also correct, but this is certainly not the case with the more westerly part of it which represents the northern portion of Jubbulpore. ...
>
> For the southern portion of the Jubbulpore District which formerly constituted that of Seoni, ... there exist very few correct materials. Should you consider documents such as those which accompany this...of any service, I should...be able to furnish...similar data... between Jubbulpore and Seoni, and eastwards from the latter place through the Mandla pargunnah into Sohagpur, and thence westward back again to Jubbulpore. ... No survey has been made of the tract so included [pl. 3]. ...

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[1] MRIO. 42 (1), original ms. ; Hooghly Dist. ; MRIO. 38 (7–10). [2] ib. 60 (16). [3] MRIO. 28 (10–13).
[4] DDn. 316 (69–71), 16-8-33.

> When in Calcutta at the end of 1837, ... I had a map prepared in your office under...Mr. De Penning of the route through Chutia Nagpore to Rattanpur, preparatory to rejoining my station of Seoni by that route. While traversing it, I took observations similar to those which accompany this. ... These...I...forwarded to a youth named Behari Lal, at present studying in the Kirk Assembly's institution in Calcutta, for...the calculations required. ...
>
> There exists in this office a map of all Jubbulpore proper...north of the Narbaddah, excepting Sohagpur. This appears to have been prepared...by Major Home, ... chiefly from information obtained through natives. ... I find it to be most surprisingly correct [III, 87][1].

Three months later he forwarded a sketch along the Mirzāpur road,

> with...observations taken at my several halting places. I also forward a second sketch... exhibiting a portion of the rich haveli tract[2] west of Jubbulpore [and adding to]...the work of Captain Robb, formerly Assistant Quartermaster General at Saugor [III, 499]. ... A third sketch...is that of the environs of Seoni by Captain Wheatley, ... and a fourth is a sketch... by the same officer of route from Ramnagar via Ramgarh to Amar Kantak, ... with only an approximation to correctness.

He suggested that Bedford should send him a rough copy of his official map that the spelling of names might be checked. He further reported that

> Dr. Spilsbury, our Civil Surgeon, who yearly accompanies the Commissioner on his tour, and has now twice visited Amar Kantak by different routes, has recently completed a sketch which has been neatly copied on a scale of 8 miles to the inch by Captain Reynolds, Superintendent in the Thaggi Department, of the country between that place and Jubbulpore [271][3].

In due course district maps became available from the revenue surveys, though the earliest had no trigonometrical control [228; 289–90]. The various general maps published in England, such as those by Arrowsmith and Allen were very much out of date. It was one of these that De Penning sent up to Everest in 1834;

> I have at last succeeded in purchasing a good map of Bengal and Bahar for the trifling sum of Sa. Rs. 2 in lieu of the one injured in its transmission to you [296]. The map is mounted on cloth and rollers[4].

MAPS FROM REVENUE SURVEYS

Though from their start the revenue surveys of the Upper Provinces had been recognized as valuable material for topographical and general maps, and the surveyors had been directed to sketch in all the main features of their village areas to that end [III, 150, 158; pl. 24; IV, 233], they could not be accepted for the Atlas of India until linked up by the Great Trigonometrical Survey [303].

Field surveyors showed all their topographical detail in the "general" or *pargana* maps, which they reduced again to the ¼-inch scale as "geographical maps"[5]. Though they were relieved from the preparation of these latter by the Conference of 1833 [211–3], the necessary material was sent in to the Deputy Surveyor General, and largely incorporated into the 8-mile maps lithographed between 1834 and 1840 [285–6].

Among the maps completed by Bedford is a large paste-up on the ¼-inch scale covering all the revenue surveys of the North-Western Provinces, 1828–42, showing district boundaries and names, and another of the *doāb* from Allahābād to Delhi, scale 5½ miles to an inch[6]. After his transfer to Calcutta, the Revenue Board established their own lithographic press at Allahābād and, to meet local demands, printed off district maps roughly compiled from the revenue surveys[7] [313]. They realised

> that the enormous expense...in preparing accurate maps has been made to serve only the purpose of Revenue. Valuable surveys, after their immediate purpose has been completed, are thrown aside as little better than lumber, and in a few years a great part will not be forthcoming—will be destroyed by damp and insects—or at least rendered difficult to decipher—unless means are taken to multiply copies, and render them useful to the public.

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[1] D. F. McLeod to DSG., DDn. 390 (88–91), 2–6–40. [2] government lands [I: 144 n.1]. [3] DDn. 390 (137–9), 11–9–40; *JASB.* IX, 1840 (889–903); Patrick Alex. Reynolds (1800–68); Mad. Inf. [4] DDn. 307 (63–4), 11–4–34. [5] MRIO. 17 (32), Delhi & upper *doāb* 4 m. to inch, April 1831; ib. 28 (33–5); Central *doāb*, June 1834, and many others. [6] MRIO. 15 (37), 16 (1). [7] some by fd. units, others at hdqrs.

> The Magistrates' and Judges' courts, the Commissioners' offices, the Military establishments, which require to know the topographical details, ... are totally without means of procuring the information they may require. ... The Collectors' Offices have...but few detached pergunnah maps for their use, obtained through the kindness of the Surveyors and abstracted from the settlement papers.

They urged that this state of things should no longer be suffered[1], but Bedford challenged their suggestions ;

> The expense of preparing maps...was by no means confined to "revenue purposes", for a general geographical map of the North West Provinces was, to the time of my leaving Allahabad, under compilation [pls. 4, 11] in which, by instructions from the Surveyor General, ... every station of the Great Trigonometrical Survey met with by the Surveyors was introduced ; also all conspicuous objects...likely to be fixed by the junior lines of that survey [233]. ...
>
> This leads to me the second mis-statement, viz., that Collectors were merely supplied with a few detached purgunnah maps, and that "through the kindness of the Surveyors". So far from this being the case, in every survey District Collectors received from the Surveyor (not from his kindness, but in the common routine of office duty) a book of plans, and a general map of every pergunnah as soon as they could be prepared after survey.
>
> Originals or duplicates thereof were transmitted to my office, not to be "thrown aside as useless lumber", but to be compiled into the valuable map above-mentioned for geographical purposes, and ultimate verification by...points fixed by the Great Trigonometrical Survey[2].

The maps lithographed at Allahābād, were of definite value at the time, even though the compilation was far from trustworthy, and the detail shewn by the surveyors after the speed-up of 1837 was of the scantiest [218][3]. Their preparation was, however, supported by the Survey Committee at Calcutta [297–302], and a resolution of the Bengal Government was passed on to Bombay where revenue surveys had practically no technical control [237].

> From these every proprietor ought to be able to obtain at a trifling cost a map which should be a record of the boundary of his property and of its minute topography [181, 206]. All the original maps must be drawn down to the most minute details according to one plan, ... capable of being at once understood[4].

Bedford did not hesitate to point out that "there never was any great native demand for plans"[5].

Markham notes that the Surveys of the North Western Provinces were

> as geographical material...perfectly useless [218]. These were the materials from which the geographical maps on a scale of four miles to an inch were lithographed at Allahabad, after having been reduced by native draftsmen. They have no trigonometrical points, and no basis of any kind ; yet from these maps the sheets of the Indian Atlas have been filled up[6].

He was not quite accurate, for none of these Allahābād maps was sent to London. It was not until 1844, after Wroughton had succeeded as Deputy Surveyor General, that sufficient trigonometrical data became available. He then had them adjusted to the Great Trigonometrical Survey and re-lithographed at the Government Press at Calcutta [311–2] ; copies were then sent to London for incorporation into the Atlas sheets[7]. Similar district maps were then compiled for the Lower Provinces, though Cāchār [pl. 9] and other eastern districts were not connected to the trigonometrical survey for many years.

The following is a typical descriptive note ;

> Memoranda to accompany the lithographed Revenue Survey Maps intended for transmission to the India House.
>
> Map of the District of Cawnpore, surveyed by Lieut. S. A. Abbott in 1938–39, scale 4 British miles to the inch. The meridian lines and perpendiculars thereto are drawn. Contains table of co-ordinates of the principal survey points of the districts of Futtehpoor and Cawnpore and the Ganges River.
>
> The inflections of the boundaries common to Etawah and Farruckabad correspond nearly, but the extreme distance from the Jumna to the Ganges somewhat differ, this map giving

---

[1] from Rev Bd. NWP., 14–6–39 ; BRC. 10–10–39 (6).

[2] from DSG. 6–9–39 ; BRC. 10–10–39 (11).

[3] v. MRIO. 24 (10*a*), Allahābād, 4 m. to inch, drawn Jaynarain Biswas, exd. M. Burke ; ib. 24 (60) ; Cawnpore ; autog. H. M. Elliot ; *IO Cat.* ; (206) ; Henry Miers Elliot (1808–52) ; BCS. 1826 ; *DNB.* ; Sec. to Rev. Bd.

[4] BRC. 2–9–30 ; BO RC. 101, 1839 (79–121).

[5] DDn. 297 (173–6), 5–11–39.

[6] Markham (181).

[7] DDn. 459 (78, 231–5), from DSG. 1848 ; MRIO. 5 (1–2), Delhi ; 1824–40, recompiled 1848, 4 m. to inch ; litho. 2 vols. of dist. maps, compiled 1845–51 ; corrected by GTS. ; *IO Cat.* (165–6) ; *JASB.* XIV 12–8–43 ; complete set for LP. presented to ASB.

> ¾ mile in excess, both...of the Etawah and Farruckabad maps, while the distance between the Jumna and Ganges on the Futtehpoor side shews a difference of 4¾ furlongs.
>
> The bearing of corresponding lines on the Cawnpoor and Futtehpoor maps shew a difference of 40′. The same comparison in regard to the Etawah map exhibit a difference of 50′. The only trigonometrical points apparent to this district map are those of Christ Church [68] and Sevada House, both situated within the cantonments.
>
> The original from which this has been compiled is in good condition, and evinces as much care in the preparation as the generality of revenue survey maps, and from the comparisons made, I consider it in every way entitled to confidence[1].

The application of trigonometrical control by connecting a few points long after the detailed survey had been carried out from traverse lines—burdened no doubt by errors altogether indeterminate—was far from satisfactory, as was well known to both Everest and Waugh. They repeatedly urged that for good maps it was essential that triangulation should precede the detail survey [214, 233, 262].

Many of the atlas sheets that were prepared from this doubtful material were still in use more than fifty years later.

HIMĀLAYAN AREAS

Reference has been made to a map of Kashmir compiled by Alexander Gerard from information collected from Indian travellers [III, 276]. An even more interesting map is described by Claude Wade, who writes from Ludhiāna in 1836[2];

> About 2 years and a half ago, a native of Bokhara, by name Abdul Rahim, who had been residing for some time in Hindustan, applied for a passport, stating that he was about to return through Kashmir and Skardo to Turkistan, and offering to give me information relative to those countries. ...
>
> On his arrival in Kashmir he forwarded a journal of his route passing through the hill State of Jammoo which, as adding to the scanty knowledge...of the Sikh dominions, was an acceptable document. ... The famine which occured in Kashmir about the time of his arrival detained him there, ... and he employed himself in collecting information on the history and present statistics of that country, communicated to me in two octavo volumes of closely written manuscript. ...
>
> From the same source I lately received a map, or...panoramic view of the valley. ... Notwithstanding the rudeness of its construction...its value...consists in the extreme minuteness of its information, there not being any place, even the most inconsiderable, omitted. ... I annex a few notes...of its remarkable features.
>
> My chief object...is to draw ..attention to...the countries lying beyond our frontier. It seems highly desirable...that means should be placed at my disposal of availing myself of the services of any individual who may appear...to possess qualifications. ...
>
> With regard to the countries on and west of the Indus, every provision has...been made. ... On the east and north of that river above Attock, since the time of the late Mr. Moorcroft [III, 485] nothing has been done...to improve our knowledge...[and] keep us informed of passing events. ... The best of all modes would no doubt be to employ an...enterprising European officer...without being further accredited than were Mr. Moorcroft, Lieuts. Conolly and Burnes, or the late Dr. Henderson.

John Henderson, a Bengal surgeon[3], who had visited New South Wales and Tasmania, made a "journey to Little Tibet [Skardo], Cashmere, and to the Indian Caucasus [I: 67]" and "introduced the silkworm of Little Tibet on this side of the Sutlej". He died at Ludhiāna 12th March 1836, and Vigne laments that his death "has deprived us of authentic...knowledge respecting the valley of Suhat, Bonier, the valley of the Deer river, and the country of Bajawar"[4].

Though Wade's interests were primarily political and commercial, he thoroughly understood the importance of correct geographical information, and this particular agent had indeed made a valuable contribution as the following notes will show.

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[1] DDn 458 (243-9), cf. MRIO. sd. Wroughton, DSG., 18-9-46, 25 (13), Mynpoori, 4 m. to inch; tables of GTS. stations; Waugh's estimate of these rev. svys. and maps, *PR.* (32-5).

[2] DDn. 294 (202-14), 4-7-36.

[3] (1795-1836); Crawford, II (80-1); *Roll* (B. 763); *As J.* XXI, 1836 (12).

[4] Swāt, Buner, Dīr, Bajāwar; Vigne, I (119), II (310); *JASB.* XIV, 1845 (660).

The paragraph numbers correspond with references on his maps.

1. *The Pir Punjal* mountains, with 2 temples at the top of one of the peaks, near which passes the road to Lahore.

On the mountains east of *Pir Punjal* is an extensive pool called *Kaosir Nag*[1], ... four or five miles in circumference, and situated on a tableland. Two roads pass by it...in the direction of Jammu, ... named *Nariyao* and *Kobal*. ... The waters of *Kaosir Nag* escape into the valley by a cascade called *Kharbel* [Haribal], estimated...to be 250 yards in height.

At the foot of these mountains is the pergunnah of *Drosir*, ... one of the richest in the province. West of *Drosir* is a pass called *Ladao*, by which the Sikhs entered Kashmir over the *Pir Punjal*. The Sikhs in their second invasion turned the *Hirapur* Pass by a road which leads directly from Dubjan to Shropian [Shupiyan] in the valley[2].

To the west of *Pir Punjal* is the pass of *Catcha Ouller*, said to be very difficult. ...

There are several passes between the *Pir Punjal* and *Bara-Mula*[3], but from the inaccessible nature of the mountains...they are seldom used. The one called *Tosah Maidan* is the most traversed, and is the one by which the Sikhs entered the valley on their third expedition. It leads to *Poonch*. To the west of *Tosah Maidan* is a high range called *Guli Marg* (*marg* means a flowery plain in the Kashmir language), celebrated for verdure and the richness and variety of its botanical productions[4].

2. *Muzaffarabad*, at a short distance above which the river *Jehlam* leaves the valley and enters the mountains. The Jehlam flows through the mountains at *Bara Mula*, where all the waters of the valley are collected. North east of *Bara Mula* is the district of Kawraj [Kajnag]. There is a small stream named Roham [Pohru] running through it by which all the wood used in Kashmir, whether for building or fuel is brought, the mountains towards its source producing timbers of every kind, and the largest cedars[5] to be found in the province.

Kawraj possesses sulphureous mines which are said to be subject to irruptions every thirteen years. The natives of this part of the valley are celebrated for their handsome features and fairness of complexion.

3. The road across the pass to *Khoyamir* which leads to *Skardo*, or little Thibet. ...

4. Road to Ladakh across...river...*Sindh*, the source of which is not accurately known.

5. The *Takht-i-Suleiman*[6], an isolated rocky hill near the city, from the summit of which Mr. Vigne, the English traveller, has taken a panoramic view[7]. ... Southward...is the town of *Pampur*, ... surrounding which the saffron of Kashmir is principally cultivated. It is also famous for a sulphuric spring, the medicinal qualities of which are held in great repute. ... There is another chalybeate spring in the vicinity.

The gracefully serpentine course of the river Jehlam between this place and the city is strikingly beautiful when viewed from a height, and so regular as to appear more the work of art than of nature.

Near *Pampur* is one of the direct passes to Ladakh called *Marewadwan*. It comes out of *Drass*, and is the way by which *Zorewar Singh*, the Sikh officer, lately conducted his expedition to Ladakh.

6. The *Mai Sam*, an avenue of poplars, 2½ miles long[8], contiguous to the...exercising ground of the Sikh troops.

7. The fortress of *Sherghar*, built by *Amir Khan*, one of the Afghan governors, now occupied as a garrison by the Sikhs.

8. The spring of *Ver Nag*, the lower of the two sources of the *Jehlam*. The upper one is a little to the east of it. From the town of *Shahabad*, near the sources, ... there are three roads passing over the...mountains ; one called *Gohan* which leads to Kishtwar, the second... to the *Banahal* territory, and the third Nabughan [Naughug], which...is not so much frequented. There is a still more direct but difficult road than either of these, *Banahal*[9].

9. A gigantic Hindu [temple], said to have been built in the time of the Raudus, sometimes called *Mattan* from the...low alluvial range on which it stands. Immediately to the north of the river are three sacred springs called *Cashmeer Bawan*, built round with masonry and forming deep cisterns.

There are three other places in the valley of equal sanctity with *Matan*, and ascribed to the same era. One near *Wautiwan*. The second near *Patan*, and the third on the top of the *Takht-i-Suleiman*[10].

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[1] Konsa Nag ; Vigne, I (292). [2] Afghāns under Ahmad Shah Durani conquered Kashmir 1756 ; Sikh conquest 1818–20. [3] Vigne, I (146–8) lists 20 passes into Kashmir from all directions. [4] a popular holiday resort from about 1880. [5] *deodar*. [6] Hindu name *Shankacharya*. [7] cf. Montgomerie's panorama of 1857 [V, pl. 15] ; MRIO. Misc. [8] from Drojan, at foot of Takht, to 1st bridge, *v*. Melville's town svy. of 1859, MRIO. 183 (30). [9] road from Jammu now crosses this pass. [10] for description of these Buddhist ruins, *v*. Vigne, I (385–406) ; Percy Brown (175–84).

> 10. The old royal palace built by the Emperor Akbar, behind which, crowned by a fort, is the hill called by the Muhammadans *Koh Maran*, and by the Hindus *Hari Parbat*, the scene of the Shah Shujah's captivity [281]. ...
>
> 11. The celebrated garden of Shalemar, commenced by the Emperor Akbar and finished by Alamgir[1].
>
> 12. The gardens of *Nishat* [gladness] and *Nasim*, so called from the names of two favourite slaves of the Emperor *Jahangir* by whom they were erected[2]. ...
>
> 13. The garden of *Dilwar Khan*[3], ... generally assigned to the accommodation of European travellers.
>
> 14. The residence of *Khooja* [Khwaja] *Mohammad Shah Naqshband*, a man much respected in Kashmir...on account of his descent from one of their most famous saints, and remarkable for his friendly attention to Europeans. ...
>
> 16. The lake called Oolar [*Wular*], 25 miles long by 10 broad, at the north-western extremity of the valley, having a small island on which stands a *masjid*[4] built by *Zynul Abuddin*, [Zain-ul-Abadin] an early ruler of Kashmir.
>
> 17. The lake called *Dal*, containing several islands, the principal of which is called *Chobar Chinar*[5], from four large plane trees planted by Zynul Abuddin. It was adorned by a pavilion now in ruins, which was a favourite resort of the Mogul Emperors in their visits to Kashmir. Two of these trees are still extant, noted for the richness and beauty of their foliage.
>
> A neighbouring island called Roopalank [Rupa Lanka] was laid out in the same manner, but it has been allowed to go to decay.
>
> The mountains approach very near to the eastern edge of this lake. ... There is an intervening space...from one to three miles. The *Shalemar* gardens are confined in the rear by those mountains. ... Between the mountains and Shalemar is the village of *Harwan*, where the Kashmir paper is chiefly manufactured[6].

About 1836 Godfrey Vigne made a rough sketch of Kashmir and its passes, for which a base of about three miles was measured by Frederick Mackeson[7] and Hugh Falconer [168]. This was engraved at the expense of the Directors and published in Vigne's account of his *Travels*[8].

In 1841 a map of the countries to the east of Kashmir from Ladākh to the Mānasarowar Lake was compiled in the Surveyor General's office from the work of Moorcroft and Trebeck of 1821—Hodgson and Herbert 1816 to 1821—Moorcroft and Hearsey of 1812—Burnes' map of Central Asia published by Arrowsmith in 1831—and the work of Cunningham and Broome of 1839 [269][9].

In 1838 the Calcutta drawing office compiled a map covering the Darjeeling hills south of Sikkim, taken mainly from the surveys of Charles Weston of 1822 [III, 20] and a sketch made by Herbert in 1830[10] [III, 458].

Everest's chart of the Great Arc shows much of the detail fixed by secondary and minor work [80-1, 111 n.4], with many points of interest in the hill stations—Dehra Dūn; Surveyor General's field office, Zephyr Hall, Gurdwara (Sikh Temple)—Mussoorie; Banog, Hathipaon, Park House, Priory, Abbey—Chur Peak, 12,956 feet—Simla; Magnetic Observatory, 7,206 feet, Church, Government House to east of church, Jakho Hill, Tarib [Tara] Devi [102 n.5][11].

QUARTERMASTER-GENERAL'S DEPARTMENT

Few of the Quartermaster-General's officers were now employed on field surveys during peace time, though both Bengal and Bombay still prepared maps of military interest. In 1834 De Penning asked for orders

> about maps required by Captain Garden, Assistant Quarter Master General, for...constructing a sketch map of the Punjab. The maps now called for are in daily use...for the compilation of the Indus map [293, 311], and which is now nearly completed, some delay having occurred ...from being obliged to sponge out a great part of Lieut. Burnes' work to introduce Captain Wade's [273], there being a wide difference between the two surveys. ...

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[1] built by Jahangir (1605-27), *not* by Akbar.
[2] Nishat built by Asaf Khan, an official of Jahangir.
[3] near Mar Canal.
[4] ruins still exist on Lanka I.
[5] or Sone Lanka.
[6] DDn. 294 (202-14), 4-7-36.
[7] (1807-53); with Burnes to Kabul, 1837-8; Ben Inf.; *DNB.*; *DIB.* [440, 472].
[8] *JRGS.* XI, 1841 (xlix).
[9] MRIO. 10 (23, 24).
[10] ib. 5 (11).
[11] TS. 7; part 2.

> Sending out maps from this office...in this irregular way, besides being at variance with the regulations, ... strikes the...utility of your office at the Presidency.

Everest agreed that this was "in opposition to the wishes of the Court of Directors", but could not object

> to any course...which my superiors direct and consider as regular. ... In like cases, under sufficient authority, I have sent documents under the custody of one of the draftsmen, ... with instructions always to bring them back in the evening[1].

The Directors considered that once the Surveyor General put in hand the surveys necessary for completing the Atlas of India there should be no further need for the survey of routes by the Q.M.G.'s officers[2], and directed that the original records of all such earlier routes should be passed to the Surveyor General for incorporation in the Atlas. Everest was doubtful of their value and writes to Barton [II, 380–1], who was now Deputy Quartermaster-General ;

> I have examined the four maps which you have sent to me. ... As a general question, ... a map without a fieldbook is of no worth. If accompanied by a fieldbook, the data contained in the latter ought to be so clear and concise that qualified draftsmen in my office...may be able to trace the course of each principal route without assistance [III, 194–5 ; IV, 295–6, 309].

He hoped to be able to make use of any map that showed clearly any recognizable points that had been, or could be, fixed by the Great Trigonometrical Survey[3].

The situation was immediately changed on the outset of the Afghān War, and the offices of the Quartermaster-General, both at Bombay and Simla, bustled with activity. Officers in the field, led by Niel Campbell and Garden, took every opportunity of adding to knowledge, and compilations were put in hand at the headquarter offices. It was some time, however, before the fresh material reached the Surveyor General's office [294].

AFGHĀNISTĀN & THE NORTH-WEST

Burnes' *Map of the Indus and Punjab Rivers from the Sea to Lahore* which he had submitted in December 1831[4] [243–4, 274] had been incorporated, after considerable adjustment, into a map compiled in the Surveyor General's office, *The River Indus and Neighbouring Countries*[5], together with—his survey of south Rājputāna [III, 132–3]—Wade's *Indus and Punjab Rivers* of 1833, which was a better map than Burnes's [273, 292]—Sandys' surveys in Rājputāna [III, 87 ; IV, 273]—White and Colvin, in Hariāna [II, 63–4 ; III, 24]—De L' Hoste and William Pottinger in Sind [244],—Arthur Conolly's route from Tabriz to Herāt [283]—"but chiefly Elphinstone's *Map of the Kingdom of Cabul* published 1815, from Macartney's map of 1809" [II, 271]. This was reduced to the 32-mile scale at the field office at Dehra Dūn, in 1837, and lithographed by Tassin in 1838 as

> Map of the North-West Frontier of British India, including the Protected Sikh States, Lahore, Cashmeer, Cabul, Heerat, Candahar, Shikarpore, and Bhawaulpore, together with Sinde and Rajpootana, the Indus River, and part of Beloochistant. ... In four sheets[6] [312].

Everest had already compiled another map, scale 48 miles to an inch, which he signed at Calcutta in October 1832, and had lithographed by Tassin[7] [311] ;

> Shortly before I left England in 1830 the President of the Board of Control requested me to direct my attention to...the western and northern frontier, and the countries bordering thereon. ... I have had combined into one general map the plans given by General Meyendorf of the tract between Orenbourgh and the Jaxartes[8]—the sketch by Count Mouraviev of the country between the Caspian and Khiva—the route by...Lieutenant Conolly [283]. ...
>
> Should any fresh data be collected by Lieutenant Burnes, who is now travelling in those regions, they will have to be introduced. ...
>
> The arrangement is chiefly due to the industry and ability of my Head Draftsman, Mr. Graham, and the execution to Mr. Winston[9] [III, 534 ; IV, 335].

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[1] DDn. 307 (70–1), 7 & 25–4–34. [2] CD to B., 6–3–32 (32–3). [3] DDn. 289 (76–80), 17–6–34. [4] DDn. 281 (7–17), 1–12–31. [5]. SGO : April 1834 16 m. to inch ; 10 Maps, U. IV 12 ; *IO Cat.* 136. [6] MRIO. 96 (11) ; *IO Cat.* (231). [7] GBO Lib. wall map 1833. [8] *IO Cat.* (473) ; Baron Meyendorf's map, *Khanate of Bokhara*, revised by French Royal Staff Corps, lithd. by Jervis, 1843 ; GBO. Lib. D (1) ; *JRGS.* XIII, 1843 (xxvi). [9] DDn. 283 (191–3), 29–10–32.

Burnes had his routes to Bukhāra and the Caspian mapped and published by John Arrowsmith [277] ;

> On my return to Europe [1834] I gave my original manuscript surveys, protractions, and the whole of the observations which I had made during a period of nine years, ... to Mr. John Arrowsmith. He embodied these in a large and comprehensive map to illustrate this work. ... This map has been engraved at his own expense, and is now published in the most public-spirited manner at his own risk. ...
>
> The larger map is sold separately...by all booksellers ; price in four sheets, 7s. ; in cover, 7s. 6d. ; and in case 10s[1].

The return journey by James Gerard was mapped by his brother Alexander [III, 453 ; IV, 276], who asked for

> a draftsman from the Surveyor General's office...during my stay at the Presidency...to copy out part of the map of my poor brother's route from Herat to Peshawar, as I...wish to sail for England as soon as possible. I shewed Sir Charles [Metcalfe] three sheets of the map copied by myself, and I intended to have finished the rest, had I been able. ... I have laid down the whole route on paper, so it only requires to be copied...under my own inspection. . .
>
> Mr. McVicars [350]...has offered to complete the remainder, ... but he can only attend me in the mornings for about two hours, since he must be at the office by ten. ... He is a very good draftsman. ... The map is intended for Sir C. Metcalfe[2], and I shall draw up a memoir of its construction[3] ;

The absence of a firm hand on the policy of map making was never more strongly felt than between the Afghān campaigns, when the Army was much more interested than was the Surveyor General, and when no single office had access to all the material. Bedford appealed for help to the Quartermaster-General ;

> Government have just called upon me for a map of Afghānistān with all the newest surveys [282–4]. At present we have very few indeed, and if Major Garden be constructing a map with all the recent information, it can hardly be worth while to commence on one here, until we have better data. ... What we want most are the positions of some of the principal places to be fixed by good observations for latitude and longitude. The latitude of Candahar in different maps varies to the extent of one degree and upwards[4].

He asked whether plans just received were based on new observations, or "merely taken from existing maps,[5]" and Garden replied that

> the only latitudes which I had leisure or opportunity of taking myself were those of Kandahar, Kabul, and Lahore, and I was obligingly furnished by Captain Sanders...with the latitudes of places between Shikarpoor and Kandahar, and by Dr. Griffith...with those of places between Kandahar and Peshawar [282][6]. ...
>
> I would...suggest...procuring the maps and plans of the...surveyors with the Army of the Indus, and who were supplied with the requisite instruments.

Bedford than wrote to several of the field surveyors, and by September had received sufficient material to make a start, though "no memoir or report accompanied these plans"[7]. His official map was compiled and lithographed on the scale of 8 miles to an inch, in 15 sheets, and followed by a reduction on the 16-mile scale, crowded with names[8]. It showed nothing of the surveys west of Kandahār towards the Helmand, compiled later by Fraser-Tytler [283–4 ; pl. 16].

In London Walker produced three editions of *A Map of the Countries on the North-West Frontier of India*, 24 miles to an inch, between 1841 and 1842—*Kashmir, Ladakh and little Tibet, and Countries between the Sutlej and Oxus*, 20 m. to inch[9]—and a *Skeleton Map of Afghanistan and Cashmir, 26 miles to the inch.* Other maps were issued by William Allen and James Wyld.

The Quartermaster-General's office at Simla produced another map of Afghānistān in six sheets, scale 8 miles to an inch, drawn by Arthur Becher with fine bold hills. Though listed as Captain Garden's map, it is countersigned by Bedford, 8th March 1842[10]. Fraser-Tytler's map is thus described by Markham ;

> As soon as the Afghan war was over, ... Fraser-Tytler...began the compilation of a general map and completed it in the following two years. ... *Map of the Western States of India and*

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[1] June 1834 ; *Bokhara*, I (xxvi). [2] acting GG. after Bentinck's departure [I]. [3] DDn. 297 (46), 28–12–35. [4] DDn. 389 (53), 16–5–40. [5] DDn. 411 (223), 20–5–40. [6] DDn. 390 (78–80), 1–6–40. [7] DDn. 408 (65–6), 1–6–40. [8] *IO Cat.* (478) ; MRIO. 111 (4–8) ; *Geo Mag.* I (5). [9] BM Map Room, 20-a-10/S-222 (10) ; MRO. Map 562 ; *IO Cat.* (255–6) ; MRIO. 111 (9), and Misc. [10] ib. 112 (36–41) 1841.

> *of Afghanistan.* ... Scale 16 miles to an inch. From the mouth of the Indus to Bokhara, and from the Sistan Lake to the longitude of Delhi. This map, with the original surveys is the most important geographical work connected with the Afghan War. ...
>
> The map was forwarded to England, and presented to the Court of Directors with a memoir, through Captain Tytler's father. ... The Court...at first refused to accept the map because it had not been received through the regular official channel: eventually...the new work...was embodied in a revised edition of Mr. Walker's map which was issued in 1857. We suspect that one reason for the neglect of...Fraser-Tytler's original materials was that the map of Mr. John Walker...had already been published, and that they arrived too late. ... Walker's... first edition contains none of the work...collected and embodied in the map by...Fraser-Tytler[1].

A very full map on scale 16 miles to an inch was completed in the Q.M.G.'s office in 1871, in four sheets, and one of Central Asia on reduced scale of 64 miles was drawn in 1869 by Captain C. J. East, part of which has been slightly reduced for plate 16[2].

CALCUTTA DRAWING OFFICE

When Everest became Surveyor General in 1830 the Calcutta drawing office under the charge of John Graham was largely employed on the copying of old surveys for the quarter-inch Atlas, and the compilation of a few general maps specially called for.

Everest reported that the 8-mile administrative map required for the Revenue Department would stretch 12 degrees from north to south and 22 from east to west, measuring about 9 feet by 16. It would contain 90 square degrees of actual mapping out of a total of 264 [285].

> The proportion of time in compiling and drafting is as 3 to 1. The mean salary of one individual...(that is, ¾ compiler and ¼ draftsman) will be Rs. 196 per month.
>
> About 18 days (including 2 Sundays) will be required for the projection of the lines of latitude and longitude, compiling, and rough drafting, of one square degree. ... Then...4½ years...[would be] required by one individual to finish the map, i.e. compiling and rough drafting --and the cost...Rs. 10,584.
>
> Secondly; Copying the map on transfer paper in sections of one square degree, for...being lithographed. A draftsman will require about 12 days to copy on transfer paper one square degree. ... Three years, at Rs. 100 per month salary of a draftsman capable of working on transfer paper, ... Rs. 14,184. ...
>
> A compiler then would take 4½ years to complete the map, and a draftsman to copy the same on transfer paper would require 3 years more; but setting them both together to work, the whole would even then require not less than 4¾ years. But by employing 3 compilers and 2 lithgraphic draftsmen simultaneously we shall be able to expect it to be completed in the short period of 18 months[3].

He protested against having to sign copies of maps and surveys for which he was not responsible;

> The Secretaries, and particularly the Chief Secretary, ... send maps to my office to be copied, unaccompanied by any details descriptive or explanatory. The copies are made by extra draftsmen engaged for the purpose, ... and then go forth bearing my signature. ... The conjectural information given by travellers is only worthy to a certain extent, and...should not be put on a par with that which has been more systematically obtained. The materials on which any map is founded ought to be thoroughly sifted, and any copy issuing from this office should be vouched for. ...
>
> Several maps...have come of late from Lieutenant Pemberton, ... who seems to be authorized to act entirely independently of me [262-3]. ... He is styled surveyor of the Eastern Frontier, and his maps go originally to Mr. Swinton[4], who sends them to me to be copied [III, 63]. Some of these profess to be compilations, some...from the route of one person, some of another, and as no explanation is given, and I am not even referred to except as a copyist, it seems to me somewhat...at variance with the wishes of the Court of Directors.

He asked for authority to call on officers for such particulars about their maps as he might think necessary[5], but Government did not entirely agree [293, 360];

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[1] *Geo Mag.* I (3-4), a portion of map faces p. lv on reduced scale; MRIO. 111 (10-13). [2] 10 Maps, L/XIV/33. [3] BTC. 11-10-31 (21). [4] Sec. Pol. Dept. [III, 63]. [5] DDn. 265 (320-1), 18-10-31.

> The maps...have reference to reports from officers employed in the Political Department, either residing at foreign courts, or in territories beyond the sea, as in the instance of Major Burney, Mr. Maingy, and Dr. Richardson [264–5], or in countries...the geography of which is little known, such as Arracan, Assam, Munnipore, and Cachar.
>
> Such maps and plans...cannot always be constructed on correct and scientific principles, nor are they expected to be so, but they serve to illustrate the reports, ... and may be found useful on future occasions, although they could not, of course, be relied on as sufficiently accurate to be introduced into any map...under the authority of the Surveyor General. ...
>
> The copies...have never been required to bear any attestation which could stamp them with official authenticity, further than as they were copied in his office. ... It is, however, obviously desirable...that the data should be known, in order that the value to be attached to the maps may be ascertained. Maps, therefore, sent for deposit are in future to be accompanied by an explanatory statement of the data[1] [360].

After Everest's departure up-country at the end of 1832, the general supervision of the drawing office fell upon De Penning, who was often confused by peremptory orders for work which interfered with maps in which the Surveyor General was personally interested. He points out that

> the compilation of the map of the "Indus River and Adjacent Countries" (ordered by Government to be put in hand immediately) [293], and the making fair copies of the two maps of Sind by Lieuts. Pottinger and De L'Hoste [244]...suspended for a time your compilation map. But as the Sinde maps have been recently completed, your...map has been resumed, and, together with that of the Indus River, is in progress[2].

From time to time there were disasters through the despatch of maps during the rains [III, 358], and Everest writes in August 1833 ;

> Major Rennell's map of Bengal and Behar arrived here 5 days ago. Owing to bad soldering the bottom of the case had come out, and the map looked as if it had been dragged through a river. It is, of course, utterly ruined, and another must be purchased [288]. Pray let this be a warning [of] what we have to look for at this season of the year, and let no map be sent in a suspicious case ; ... it would be better to have all the fastenings pinned as well as soldered, and proved watertight before use[3].

After taking over duty as Deputy Surveyor General at Calcutta, Bedford became responsible for the drawing office, and in 1839, under the direction of the Governor General, Lord Auckland, he drew up rules for the control of mapping, of which the following are amongst the more important. Amendments ordered by the Governor General are added in brackets.

> 1. Map Register to be kept up by Map Reports on 1st January of each year from the different Government offices. ... (Might be furnished...after...six months).
>
> 2. These reports might be published annually by the Surveyor General's office, in the form of an appendix to the Map Committee Register [297]. ...
>
> 3. All maps containing new materials, or such as may not have been worked up in the Surveyor General's office, now in the possession of any officer of Government, to be made over on application. ...
>
> 5. No geographical maps, plans, or routes, to be hereafter compiled at the public expense except at the Surveyor General's office. ...
>
> 8. No original maps to be delivered out of the Surveyor General's office, ... nor any copies, except under the authority of Government [II, 287–90 ; IV, 293].
>
> 9. Geographical or topographical materials not to be furnished for publication by any public officer prior to their being worked up in the Surveyor General's office, or without the sanction of Government. ...
>
> 12. Orders similar to those already issued to the Bengal Surveyors...shall be issued... wherever Revenue Surveys are in progress[4].

The drawing of revenue survey maps [288–9] had been criticised by William Morison, formerly one of Mackenzie's assistants on the Mysore survey [II, 431] and acting Surveyor General at Madras [II, 299], who was now a member of the Supreme Council. Whilst he had

> no doubt of the accuracy of the village maps, ... the drawing...is far from being uniform. ... The topographical details of the village maps [pl. 12] with the exception of those of Lieut. Thuillier [200, 207], appear to be very scanty. Every surveyor apparently draws his plans

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[1] DDn. 263 (359–63), 2–12–31. [2] DDn. 303 (35), 12–2–33. [3] DDn. 316 (73–4), 4–8–33. [4] DDn. 343 (296–301), 5–11–39.

> according to his own fancy, so that these...do not speak the same language, and they might ...represent some parts of Europe quite as much as any part of India.
>
> All plans...should be...viewed from a point perpendicularly over it. Towns and villages are easily drawn so as to shew every street. The wet cultivation should be represented uniformly in one way, the dry in another. Salt marshes, jheels, lakes, and jungles, are...all capable of being uniformly represented, and even topes of different kinds of trees can be precisely characterized, ... whether coconut, tar[1], date, tamarind, etc. ...
>
> The remedy is...easy—a circular order to the surveyors, giving...a neat drawing of each sort of land, also the different features...to be represented. ...
>
> I recollect at Fort Saint George, when the Surveyor General's office was being formed in 1811 [II, 303–4], the same defect existed, every surveyor drawing his plans according to his own taste. The remedy above suggested was then applied. In the course of a few weeks, every plan...was executed in precisely the same style. ... The Surveyor General's office at Calcutta will...contain the best specimens of every approved mode of topographical drawing. ... There cannot indeed be any difficulty in accomplishing uniformity as well as accuracy[2].

Bedford commented that he had already taken steps to ensure uniformity, but, "if highly finished topographical drawings be required, ... we have no means of furnishing them with the present establishments"[3].

At the time the offices of Deputy Surveyor General were closed down at Madras and Bombay, the Surveyor General was authorized to have all records that might be useful for general geography sent to his depot at Calcutta, leaving the remainder in deposit with the Chief Engineers at those presidencies. At his request committees were formed to go through the registers and decide what to send to Calcutta, and what to deposit locally[4]. This splitting of stocks was not a great success for there was never at Calcutta any officer with knowledge or interest in Madras or Bombay to prepare maps for local needs, and the Chief Engineers were not properly equipped for meeting local map demands [III, 316 ; IV, 298, 306–7, 328].

SURVEY COMMITTEE, CALCUTTA, 1837–41

It was not long after Everest's move up country that the Government of Bengal found that the absence of the Surveyor General led to much inconvenience and delay, especially as his only representative at Calcutta, Joshua De Penning, nominally in charge of the computing office, could take no action—and state no policy—without reference to his absent chief. This difficulty was more especially felt after the arrival in 1836 of a new Governor General, Lord Auckland, who, no less than his predecessor, showed particular interest in the progress of surveys [I, 315].

Early in 1837, apparently at the suggestion of Henry Prinsep of the Supreme Council [101 n.6], a Survey, or Map, Committee was formed at the Presidency, including three military members with experience of scattered surveys[5].

The first duty assigned to the Committee was to compile a catalogue of all maps found at the Presidency, including those in the Surveyor General's office, a task similar to that on which James Franklin had been employed in 1820 [III, 290]. For this they were given the services of Robert Pigou[6], a young Engineer officer recently arrived in the country. This *Register of the Maps to be found in the various Offices of the Bengal Presidency* was completed in 1838, and published in two volumes 1839[7]. A supplementary volume was added in 1842, giving additions for Calcutta, and lists for Madras and Bombay. The Register only records information already shown on each document, often without date or name of surveyor, and is of no great historical interest[8]. The material had either been already mapped, or was of no mapping value [301].

The committee was further charged with the selection of surveyors and draughtsmen from local candidates[9]. It trespassed more and more on the legitimate functions of the Surveyor General, and soon involved the Deputy Surveyor General, when he moved to Calcutta and was able to represent his chief more effectively than De Penning. Whilst the Governor General acknowledged the Surveyor General's responsibility for maps generally, he desired a more active policy;

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[1] *tar* = palmyra palm = *borassus flabelli formis.* [2] Morison, 15–6–39; BRC. 2–9–39 (10). [3] DDn. 297 (123–6), 5–11–39. [4] DDn. 321 (48–50); 15–10–33; 288 (217–8), 10–12–33. [5] Ezekiel Barton [II, 320–1], Fitzgerald & Irvine [III, 448, 462]. [6] (1816–41); Ben. Engrs.; kd., Afghānistān, by premature explosion, 24–2–41. [7] 200 copies printed; *IO Cat.* (620). [8] *Ben Regr. & Supply Reg.* [9] B to CD. 11–8–37 (8).

> My attention has been attracted soon after my arrival in India—to the long continued absence of the Surveyor General from the Presidency upon other duties—to the immense expence which had been, and which was yet every day, incurred...in surveys, and in the preparation of maps—and to the importance of...applying to general use the results of this expenditure—and, without detracting from the acknowledged merits of Mr. De Penning, ... to the very inadequate superintendence of the Surveyor General's office.
>
> A Committee was accordingly appointed to investigate this subject. A correct list and classification of the maps existing in all Departments have been...prepared, ... and pains were taken to apply...to the advancement of young men in the Surveying Department the mathematical education...acquired in the Calcutta schools.
>
> I need not dwell upon the importance of preserving the originals of military maps and marine charts, and of combining desultory surveys so that they may be made available for... improvement of existing maps. ...
>
> I think that we want...systematic direction. ... Copies of all that may be necessary for their peculiar purposes should be at hand in the Quarter Master General's—in the Marine—and in Land Revenue—or Judicial Departments[1].

The discussion that followed drew a minute from William Morison;

> While the Surveyor General is absent...in immediate superintendence of the Great Trigonometrical Survey, it is out of the question that the general duties of the office can be efficiently conducted [315].
>
> Practically speaking, the appointment of Surveyor General and that of the Superintendent of any survey are quite incompatible. ... This...has been lately improved by placing the Deputy Surveyor General in charge of the office, but he also has a separate charge in superintending the Revenue Surveys...with which the Surveyor General has no concern, but which is fully sufficient to engage the whole attention of one officer. ...
>
> The Surveyor General...ought to direct...all surveys, including the Great Trigonometrical Survey, ... and it is only the Surveyor General who can direct its operations to the best advantage. ... It may...be hoped that all the energies of the expensive establishment of the Trigonometrical Survey may shortly be directed exclusively to the extension of its triangles over the country where its operations have not yet been carried.
>
> The appointment of Surveyor General to succeed Lieut. Col. Everest provisionally has been announced by the Hon'ble Court of Directors nearly two years ago [317], and in case ...this successor...should also have the immediate charge of the Trigonometrical Survey, ... we might express to the Hon'ble Court our confident expectation that one of the Assistants under Lieut. Col. Everest would be found fully capable of carrying on the work [299].

He went on to stress the importance of proper control of field surveys—preservation and compilation of records—reduction and copying.

> A small lithographic drawing establishment, as already contemplated for the Revenue Surveys [288], would occasion much saving of expence, and...should...meet the calls, not only from the Revenue Survey branch, but for every purpose, ... and perhaps the existing Lithographic Establishment of the Government might be placed with advantage under the direction of [the Surveyor General] [300, 302, 313]. ...
>
> The drawing establishment of the Surveyor General's office is...quite inadequate. ...
>
> It is essential too that the progress of surveys should be constantly overlooked by the head of the Department. ... The survey of the Nizam's Dominions, which commenced...in 1815-6, is still but little more than half finished. The extent of the country is estimated at one hundred and three thousand square miles, which, at the rate of 4,000 annually should now have nearly completed. ... It is not to be supposed that such a survey...can be duly superintended by the Surveyor General, even at Calcutta [248-9]. The discontinuance of the Deputy Surveyor General's office at Fort St. George was, I think, premature, and I cannot suppose that any saving has as yet arisen from that measure. ... The same...is perhaps not less applicable to the corresponding appointment at Bombay [297, 328][2].

The new Committee was to carry out work that was already provided for amongst the duties of the Surveyor General. Everest was not consulted; he was away up-country, deeply engrossed in his work on the Great Arc [316-7]. Bedford was not consulted on the functions of the Committee, though directed to draft suitable regulations for control of the map-drawing office [296]. The Council failed to recognize that Everest's policy had the full authority of the Court of Directors, viz., to push on the Great Trigonometrical Survey with determination, and to undertake no surveys or maps unless based on that sure control and specially prepared for incorporation in the quarter-inch Atlas of India [261, 303]. Disregarding, however, the danger of interfering with an established professional department without professional advice, the Council passed the following resolution ;

---

[1] Bo RC. 101/1839 (119-21), 26-6-38. [2] minute by Morison, 15-5-39; BRC. 2-9-39 (10).

> The attention of the President in Council has been strongly drawn to the want of system which exists in respect to surveys and the preparation of maps, ... whereby the expensive operations which have heretofore been undertaken...have not been made to yield the full benefit. ... Unless all such information is readily accessible to all Departments, ... the time and money spent in occasional surveying and mapping are to a great extent thrown away.
>
> To obviate this evil, the President in Council resolves that there shall be one office, ... viz., the Surveyor General's office, in which all original maps and fieldbooks, with the memoirs relating thereto, shall be deposited. ... This is...according to the Hon'ble Court's orders .. dated the 3rd of June 1814 [II, 306 ; III, 289–92, 303]. ...
>
> It is...necessary that in the absence of the Surveyor General on detached service, the... office at Calcutta should be placed under the management of an officer competent to carry on. ... The Governor General has suggested that Captain Bedford...be employed in this situation [323, 325]. ... The Governor General has likewise suggested that the...Survey Committee may be made useful in maturing this scheme of...systematic record of all surveys. ... The present drawing establishment...must in some degree be enlarged[1].

The following year the Council passed a further resolution, establishing a Geographical Committee with more definite authority ;

> The Surveyor General is still absent, and his absence seems likely to be yet prolonged, but his place is now in some degrees supplied...by...the Deputy Surveyor General. ...
>
> The labours of the Map Committee, by which two volumes of lists of existing maps have been prepared and published, have likewise contributed to render the immediate adoption of a scheme of reform easy and natural. ... The residence of every future Surveyor General should be fixed at the Presidency, ... leaving such work as the Trigonometrical Survey to be prosecuted by a subordinate officer [318]. ... In the meantime, ... the Governor General in Council sees no reason to delay the commencement of those measures of improved...control which...are so greatly required. ...
>
> The local head of the Survey office should be assisted by a Committee of capable officers with whom he may consult on the collection and application of materials, and on the general improvement and extension of the new system. The Governor General in Council gladly avails himself of the valuable aid which the Hon'ble H. T. Prinsep has consented to give as President, ... and for its members...to appoint an officer in the Quarter Master General's Department—the Secretary to the Military Board—and Captain Fitzgerald[2]. ...
>
> The rules proposed by Major Bedford appear generally well adapted, and they are accordingly sanctioned, with ...modifications[3] [296].

The Committee promptly recommended a mapping programme ; calling for all material, of whatever nature, now in Calcutta, to be compiled on the quarter-inch scale to cover areas for which Atlas sheets were not yet available. Reductions from revenue surveys were to be obtained, and enlargements made from small-scale geographical maps ;

> A compilation has already been made on a scale of 8 miles to one inch of the...country between Calcutta and Nagpore, east and west, and the Ganges and Mahanadi rivers, north and south [287]. In respect to this tract, therefore, the object in view will be effected by little more than by merely copying on the proposed scale the map already compiled, preparatory to its being lithographed for the General Atlas.

This reads as if this important Committee actually proposed to enlarge the 8-mile map for incorporation into a quarter-inch compilation which was to be lithographed, and a copy sent to the engraver in London for the Directors' cherished Atlas. They further recommended that Atlas sheets, 119, 120, 121, near Calcutta, should be extended so as to connect this 8-mile map with the north-east frontier, to cover an area that could not possibly be reached by the Great Trigonometrical Survey for very many years. They continued ;

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[1] BRC. 2–9–39. [2] Col. Wm. Dunlop, QMG. ; Henry De Budé & Wm. Fitzgerald, Engrs. [3] BRC. 8–6–40 ; Mil Dept. to SG. 5–8–40 ; DDn. 343 (289–95).

> The sanction of Government is requested to an increase of the Surveyor General's office establishment to the extent of 4 compilers on salaries of Rs. 200 each [337], so that 4 sheets of the General Atlas may be put in hand at the same time, it being the intention of each member of the Committee to undertake, if possible, the superintendence of a separate sheet.
>
> The additional compilers will, of course, be available for general work of a geographical description, and if one sheet should not furnish full employment in the compilation, ... other sheets will be be put in hand through the same agency, by which means we...hope the whole of Bengal and Behar will be mapped from the best authorities in a very short period.

The Committee apparently expected to find trained map-compilers walking down Chowringhee, and thought that with the magic touch of amateur supervision they could produce, from materials no better than were available to Rennell, maps that should be engraved as the final Atlas of India. They had not that critical professional knowledge that had led Herbert to complain bitterly of the waste of labour involved in copying for London every scrap of material, even when of no possible geographical value [III, 293].

They concluded by recommending the allotment of a section of the Government lithographic press to the Surveyor General's work, a valuable step that was effected at once[1] [298, 313].

In view of this extraordinary programme, it is not surprising that Bedford declined a summons to join the Committee as *ex officio* member ;

> Having seen my appointment as member of a..."Map Committee", respecting which no communication had been made to me by Government, I applied without delay for the documents connected therewith.
>
> It would ill become me to offer any remarks on a measure which it has pleased His Lordship in Council to adopt, however unexpected on my part, and mortifying to my feelings. ... After an attentive perusal, however, of the proceedings of the Committee, objections still stronger than those urged against the immediate compilation of a map of Afghanistan in this office [293-4]...appear to apply to the proposed "Compilation Scheme" of the Committee. ...
>
> Even were the proposed scheme unobjectionable in this respect [enlargement to scale of Atlas, on different projection], and also in point of materials, ... it would still...involve the necessity of detaining original matter in India, contrary...to the repeatedly expressed wishes of the...Directors, who in June 1828 recorded...that the various unsuccessful attempts to execute an Atlas in India have proved the main obstacle to the timely publication of their own Atlas sheets [III, 285].
>
> At the same time they conveyed their positive injunctions to the Surveyor General that the latitudes and longitudes of all surveys sent home shall be attested by him, an injunction which seems directly opposed to the proposed scheme, and for want of the above verification maps...have been rejected for the Atlas [III, 285-6 ; IV, 303-4]. ...
>
> In May 1830 the Hon'ble Court directed minor series of triangles to be based on Mr. Olliver's longitudinal chain from Seronj to Calcutta, ... to complete the province of Bengal [12]. Again in 1833 they remark that sufficient points only are wanting to enable them to finish the Atlas sheets of Bengal and Behar, and in October 1835, repeat their call for triangulation as far as done [101-2]. It may probably be thought singular that the above points were not brought to the notice of the Committee. ...
>
> No intimation has reached me from Government...of the formation of the Committee, nor was I ever aware of their intended meetings, nor of the subjects likely to be discussed. ...
>
> Since I have had...charge of the Surveyor General's office, few of the maps...(those from the Madras surveys excepted) have been accompanied by either fieldbooks, memoirs...astronomical observations, or other documents, to establish their value. ...
>
> As a member, therefore, I should be likely...rather to embarrass than to aid their proceedings, or become personally responsible for measures in which I might not concur.
>
> During the short time, however, I am likely to continue in office, I shall at all times be ready to give my opinion on any point referred to me—to receive the suggestion of the Committee—and to the best of my power to carry through the...wishes of Government. But... I trust I may be permitted...to decline becoming a member of a body, where my voice (as one of a member) would be in an inverse ratio to the responsibility of my official situation[2].

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[1] from Geogl. Com. to Govt. of India, 6-7-40; Bo RC. 1321/1841 (1-14). [2] DDn. 408 (36-9), 1-8-40.

Bedford sent a copy of this letter to the Surveyor General, commenting that

> to hurry on the compilation of so expensive a work as an Atlas of India, with materials so imperfectly verified as a large proportion of those in this and other public offices, seemed...but little likely...to serve the cause of geography, or to add to the reputation of the office.

Everest emphatically agreed ;

> The course you have pursued is...most calculated to promote the interests and wishes of our Hon'ble employers. ... It entitles you to my warmest commendation, and will...meet with the applause and approval of the Court of Directors, who seem to be daily and hourly acquiring new proofs to convince them of the fact that over-much trash has been amassed already, and that to go on accumulating unworthy matter...is but the labour of the Danaides. ...
>
> The celebrated minute of my Lord Wm. Bentinck [III, 195–6] entirely bears you out in all you have urged, and...I send for your perusal the copy which His Lordship gave me[1].

With this support and a copy of Everest's official letter to Government [318], Bedford had to counter specious arguments—obviously inspired by the Governor General himself—to show how excellent was the scheme of the Committee[2]. To these he retorted at equal length, giving sound technical reasons why he adhered to his first views[3], reasons that were scornfully brushed aside by the Military Department. He sent copies to Everest, who protested to Government in clear and forceful words, pointing out that the proposals of the Committee were at complete variance with elementary principles. He had in 1832 asked for professional officers to take charge of topographical and geographical work [14, 327–8] ;

> My suggestion was left unnoticed. I was well aware that single-handed I was quite unable to cope with such a laborious task. ... The Surveyor General, be he who he may, will never be able single-handed to arrange the materials at present collected, assigning to each its due weight [III, 285]. ... He requires aid, ... not...from a Committee of gentlemen who—never having served in the Department at all—can know nothing of its workings [297 n.4, 299 n.2], ... but of those intelligent...deputies who have each been duly trained up in the line. ... Three efficient deputies...are...the very smallest that will suffice [327–8][4].

He asked that the whole matter should be referred to the Directors, and their reply fully endorsed the stand that he and Bedford had taken ;

> The institution of a Geographical Committee for...compiling maps of different portions of India must fail of...any beneficial result, if it does not occasion injury to the service, and lead to an unnecessary expenditure of the public money.
>
> The Committee is composed of individuals whose time is fully occupied by the duties of their own appointments, and who, besides, have never been engaged in the Survey Department, and cannot therefore...possess that particular knowledge which is essential to the accurate compilation...of maps from materials derived from various sources—arranged on different scales—and of which the data are uncertain and occasionally erroneous.
>
> It is not...surprising that Mr. Prinsep...should state that the Committee, even were it to divide the superintendence...amongst its members, would find full employment for several years in the compilation of the...of the Bengal Atlas only—that similar Committees would be required at the other Presidencies, or officers employed at salaries of 1,500 rupees per month each—and that an establishment of superior compilers or draughtsmen would be necessary.
>
> Neither are we surprised that...Major Bedford entertained strong objections to the plan, and...declined to be a member of the Committee. He was well aware...that the plan involved a serious departure from our former instructions, ... [and] that it would seriously interfere with the progress of the Atlas in this country without furnishing any adequate substitute. ...
>
> It is our earnest desire to carry on and complete the delineation of the Geography of India in such a manner as that it shall be final. ... With this view we have resolved to engrave no more sheets of the Atlas unless their contents shall be based upon triangulation. ... Combining the different surveys into sheets corresponding with the...index sheet is to be performed in this country, where the engraving of the whole is also to be executed. ...
>
> The great desideratum now is continuance of the subordinate series of triangles connected with the meridional arc, which, by fixing the exact positions of a number of places in tracts that have been already surveyed, will allow of great portions of Hindoostan and of the Deccan being finally incorporated into the Atlas [12, 303]. ...
>
> It is a matter of regret to us that you should have occupied yourselves with...compiling maps which were not immediately required, ... and...of portions of the country, the positions

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[1] DDn. 410 (142–3), 13 & 25–8–40. [2] BMC. 19–8–40 ; DDn. 407 (116–26). [3] DDn. 408 (50–7), 28–8–40. [4] from SG., DDn. 402 (115–22) ; 11–9–40.

> of which have not been finally ascertained by triangulation. For...any map which might be required for political or military purposes, such as that of Afghanistan, ... every means... should of course be made available, but to...make maps of the neighbourhood of Calcutta and of the Bombay territories appears to have been quite unnecessary. ...
>
> Any expenditure which may be incurred in the compilation of maps, other than those performed in the Surveyor General's office and under his immediate responsibility, ... should immediately be discontinued. ... Whatever additional aid may be...necessary to enable the Surveyor General to carry on satisfactorily...should be given to the extent of your ability[1].

The Committee had given endless trouble to harrassed professional officers, but had effected—the preparation of a Register of Maps [297]—the encouragement and recruitment of young surveyors and draughtsmen in Calcutta [337, 393]—the allotment of a section of the Government Lithographic Press to work for the Surveyor General's office [301, 313].

It had compelled the Surveyor General to expedite the computation and promulgation of geographical co-ordinates deduced from his secondary and principal triangulation [101–2]. Everest had indeed protested at having to produce these co-ordinates before his final computations were ready, and insisted that the data so furnished were only preliminary. It might have been wiser to have left him to his own time-table.

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[1] CD to B., Mil., 4-11-41 (1-10); DDn. 401 (70-3).

CHAPTER XVIII

MAPS, GENERAL

Quarter-inch Atlas — Maps of India — Hyderābād Survey — Bombay Presidency — Orthography — Lithography.

ORDERS for the standard quarter-inch Atlas of India were first issued by the Court of Directors in October 1823 [III, 283], and the first published sheets reached India in 1828. The lay-out [pl. 24], projection, compilation, and engraving, were entrusted to John Walker of London [III, 285–6, 295–6, 510–1], and material was to be prepared in India from such surveys only as were considered fully worthy [III, 120–1, 195, 283–6]. The Directors declared the extension of this Atlas over the whole of the Company's possessions in India to be the Surveyor General's first objective, for the control of which the Great Trigonometrical Survey was essential [9, 309]; triangulation was to be extended to "those parts of the country which have been already surveyed", giving priority to "the Bengal Provinces" [12, 261][1]. Everest doubted whether many of the older surveys were worth copying even if so connected [20];

> At the period when many of these surveys were executed, competent persons were not easily obtainable, ... and the work of...many years ago cannot of course be expected to be equal to what it is now. ... Many of them scarcely appear to me worth the trouble of copying, and...perhaps...I should...confine my attention to those which I consider most valuable. ... I have already put in hand the most valuable of the maps, ... and shall continue to make copies of others until further instructions[2].

The Directors set a high standard, and called attention to

> two sheets...drawn at Bombay, ... II-2SW. and II-3NW.[3] ... The latter does not appear to be sufficiently correct for incorporation into our Atlas. ...
>
> Major Walpole also sent the latitudes and longitudes of Ajmeer and Jypoor, which places are laid down in the survey of the district of Ajmere by Captain Hall [III, 456], but his determination of those positions is too vague...to be used in adjusting the surveys. ...
>
> We wish to impress upon the Surveyor General that the points upon which the maps of the Bengal Presidency are to be constructed must have triangulation for their basis, being convinced that the Atlas can by no other methods be rendered a permanent and useful work [III, 194 ; IV, 301]. The surveyors employed in triangulating should determine the positions of as great a number of towns as possible [12, 71].

To meet the objection against engraving in England [III, 285] the Surveyor General was to "remark upon the merits of each survey"[4], for which purpose he submitted a chart [III, 120–1 ; pl. 24] distinguishing—

> Surveys which...may be useful...when duly connected by...triangles. ... Ground covered by a series of triangles with detail. ... That covered by a series of triangles without detail. ... Imperfect work with detail. ... Perambulator and compass surveys. ... Revenue Surveys[5].

The Directors in England expected far too much of their Surveyor General. He was to bring the expensive work of the Trigonometrical Survey to speedy completion—he was to expedite the submission of material for the Indian Atlas, all accurately tied to the triangulation—and, whilst he was devoting his whole energies to the primary triangulation, they withdrew his Deputies at Madras and Bombay. They expected miracles ;

> As the expenses of the Survey Department are of large amount, and must continue to be so until the completion of the Indian Atlas, we trust that you will use every exertion to bring

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[1] CD to B., Mil., 26–5–30 ; BMC., 3–9–32 (139). [2] DDn. 265 (118), 10–1–31. [3] Arrowsmith's lay-out [III, 283 n.4]. [4] CD to B., Mil., 20–7–31 (9–14). [5] DDn. 265 (303–8), 10–11–31.

> it to an end with as much expedition as is consistent with accuracy[1]. The Surveyor General promises to send home all surveys as soon as they shall have been completed. ...
>
> They ought to be...in such a form as to be available for our Indian Atlas. ... [We have] received three drawings of pergunnahs and talooks in the Northern Konkan on the scale of two miles to an inch, but without having the lines of either of latitude or longitude drawn upon any of them. They were accompanied, certainly, with a general map of the triangulation of the Deccan by Lieutenant Shortrede, on a scale of 8 miles to an inch, but the Surveyor General must be aware of the great difficulty of transferring lines of latitude and longitude correctly from a map on a small scale to one so much larger[2].

By 1833 the Bengal Government had received thirty copies each of the thirty Atlas sheets that had so far reached India, and were able to spare a meagre two copies each for the Revenue Department. By 1843 the number of published sheets had only risen to 39, falling into groups—Gujarāt, 1—Himālaya, 7—North-East Frontier, 5—Central India, 5—South Peninsula, 18 [pl. 23]. They contained many blanks, and were particularly misleading in regard to hill features, as no suitable means had been found for indicating relative height or steepness of ground [251]. There is much truth in an unkind review of the Himālayan sheets ;

> Here he [the map-reader] will find the very perfection of confusion, confusion worse confounded. We defy anyone on his mountain travels to ascertain from these maps whether his next march will lie over the top, or along the side, of a hill, or through a valley.
>
> The great chains of mountains are marked distinctly enough, but the delineation of the subordinate ranges and inferior offshoots and spurs is singularly defective ; whilst the forest of names, chiefly those of insignificant hamlets and cowsheds, bewilders the examiner. [The survey may be accurate and the map true], but of what advantage are these merits if, through the defects we have enumerated, and the unartistic appearance of the drawing, we cannot find our way by the aid of the mountain maps, nor show them to a foreigner without a blush[3].

Apart from these defects of hill drawing, there is no doubt that Everest was justified in claiming that, being confined to surveys based on triangulation,

> the East India Company's Atlas may fairly compete, in point of accuracy, with the maps of Europe of fifty years ago, or even with that of Great Britain and Ireland prior to the commencement of General Roy's operations[4].

MAPS OF INDIA

A brief account has already been given of the general maps of India published before 1830 by London mapmakers, Arrowsmith, Cary, and Messrs. Kingsbury, Parbury & Allen [III, 287–9]. It is impossible here to notice all the maps that were published between 1830 and 1843, but as exploration and scientific survey extended over the country, so also extended the public call for maps. The Marātha war of 1816 to 1818 had been followed by a marked spate. The campaigns in Afghānistān again excited a new interest, and new maps.

Whilst the Surveyor General's draughtsmen were industriously working up official maps of particular areas from the latest field surveys, they maintained no general map. "We have no map of India", writes the Deputy Surveyor General,

> in the Surveyor General's office, nor modern one of the States beyond the Sutledge. ... To make copies of those we have would prove not only very tedious, but expensive. ...
>
> I would suggest that authority be given me to purchase Tassin's Map of the North Western Frontier for 16 rupees [312], and a Map of India from Messieurs Thacker and Company, whose memorandum of sizes and cost is hereto annexed.
>
> P.S. I also enclose a note from Messieurs Thacker and Company with the prices and description of two other maps. ... Map of India : 2 sheets. ... Extending from Cabul on the North-West to the Burmese Empire to the South-East. Size 5 feet 4 inches by 5 feet. Published by W. H. Allen & Co., corrected up to 1836. Price Rs. 50.
>
> Map of India : 1 sheet, in case. Size 2 feet 10 inches by 2 feet 2 inches [by Tassin], with additions to 1825. Price Rs. 16.

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[1] CD to B., 16–1–33 (5, 13) ; DDn. 90 (105–7). [2] ib., Mil. 22–3–37 (12–6). [3] *Cal Rev.* IV (166).
[4] Everest (78–9 .

Thacker sent these maps fitted in cases, and advised that the they had also

> the larger one mounted and varnished, and fitted in a brass tube with a self-acting spring roller. ... We have also the smaller map, but of a later edition which includes the Burmese territory, mounted in the same manner. The price of the first is Rs. 100, the other, Rs. 40[1].

In 1833 Messrs. Parbury & Allen, who were John Walker's publishers, issued in book form a set of 5 small maps of India "illustrative of the European connection with India, and of the British Administration in its several departments"[2].

(i) General and Commercial Map, including Madagascar, Arabia, and Borneo.
(ii) Political Map of India, with list of States and chronological table, scale about 140 m. to inch [pl. I][3].
(iii) Military Map, shewing stations occupied by troops.
(iv) Revenue Map, showing districts, but no roads and few place names.
(v) Judicial Map.

To illustrate Thornton's *History of India* [III, xxii], Allen issued a smaller map appropriate to the periods of each volume, *India, with British and other Possessions.* ... Scale 196 m. to inch. Engraved by J. & C. Walker. One of Allen's maps, *A Newly Constructed & Extended Map of India*, was corrected to 1836, and published in 6 sheets[4]. A later edition reached the Asiatic Society at Calcutta in 1844, and "had just been corrected at a great outlay, to the present date. ... It will cost about £10–10 s., including shipping expenses to Calcutta"[5].

HYDERĀBĀD SURVEY

It was one of the more important duties of the officer conducting a topographical survey to produce as soon as possible after each field season, not only the fair drawing of the season's work on the scale of survey, but also a reduction to the scale of the Atlas, four miles to an inch. It was the Surveyor General's responsibility, either to send these reductions home in original, or to assemble them for the engraver in London, preferably by degree squares [III, 284]. Everest had much to criticise in the first reductions he saw from the Hyderābād Survey ;

> The map on 4 miles to an inch, being particularly needed in the preparation of the Atlas, ... is so confused as to be totally illegible, and I am...returning it in order that one more fit to appear before the Honorable Court of Directors may be prepared. ... If it is unintelligible to me, who know that country well, by how much more must it be so to the engraver at the India House, who never was out of London.
>
> The names are badly written, and in the large sloping characters of common letter writing ; they occupy, therefore, twice the size that they ought to do. Moreover, they are written in paler ink than that used in delineating the jungles. ...
>
> The jungle is too darkly shaded, and there is too much of it ; the whole is too highly coloured, and very badly executed. Too much labour has been bestowed upon what is immaterial, too little upon the really important points of a map, which in all cases ought...to give information, and not to shew the powers of the draftsman.
>
> The features of a map for geographical purposes seem to rank as follows ;
> 1st. The positions and names of places, and their distinguishing characteristics.
> 2nd. The courses of rivers.
> 3rd. The courses of roads.
> 4th. The lakes and reservoirs.
> 5th. The courses of ranges of mountains, together with the nature of their declivities.
>
> Last of all the ornamental, which is applicable only to convey general notions of the prevailing conditions of the different tracts.
>
> Be so good, on this as on all future occasions, to use as little colour as need be, and let what you do use be very light, and put on with a full brush[6].

In 1837 De Penning was compiling a special map for the Resident

> on a scale of 4 British miles to the inch. In size it measures 6 feet 9 inches from north to south, and 9 feet 6 inches from east to west. If formed into one map it would be too large and

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[1] DDn. 408 (7–8), DSG., to NWP. Govt., 11–3–40. [2] engraved by John Walker ; submitted to H of C., 1831 ; BM Map Room, 13–d–24, IO. Lib. RR-28. [3] similar to SGO., map, scale 103 m. to inch, MBIO., 94 (48). [4] *As J* . XIX, 1836 (278). [5] *JASB.* XIII, 1844 (xlv–vi). [6] DDn. 267 (99–101), 16–1–32.

unwieldy. It has therefore, been divided into 4 sections. When the original compilation (which must be retained in the office) shall have been completed, a copy will be prepared from it, and forwarded to your office without delay. ... The compilation...will be a work of some time, probably a twelvemonth[1].

BOMBAY PRESIDENCY

By 1833, when the office of the Deputy Surveyor General at Poona was closed down, Jopp had submitted the necessary quarter-inch reductions of all Bombay surveys [III, 281], but was still engaged on a full map of the Presidency connected up by Shortrede's triangulation ;

> It is to me a...great regret that the intended abolition of this branch of your office was not sooner communicated to me [328]. Had it been, my attention would have been directed to the formation of maps of the whole presidency. ...
>
> I had commenced this work in so far as the regular surveys extend, and on sheets each containing one degree, leaving those parts which required to be resurveyed until the means of making them worthy of insertion into the general Atlas of India should be obtained by fresh surveys, or by the extension of the trigonometrical operations over them [240]. ...
>
> Should such maps as you do not yourself require be lodged in the office of the Chief Engineer, many valuable routes and other information not yet compiled will be virtually lost from the want of some person...to put them all together, and the general map of this part of India will remain in an unfinished state[2].

There was no help for this, and whilst a selection of the maps was sent to the Surveyor General's office at Calcutta [327–8], the greater part was transferred to the Chief Engineer. Thomas Dickinson, an experienced surveyor [II, 395], had in 1835 the utmost difficulty in meeting a request for

> separate maps...of the several Collectorates, ... nine in number, shewing the boundaries of the principal and sub-divisions, and also of each pergunnah. ... From the very inadequate data... I must despair of even imperfectly executing such an order without the cordial co-operation of the Revenue Commissioner and of the several Collectors, and the services of the...native draughtsmen under them [297]. ...
>
> The map of the Satara territory was unfortunately among the documents required by the Surveyor General, and...sent round to Bengal, of which there is no copy in this office[3].

He was allowed to entertain extra draughtsmen, and was able to collect material from the districts, though much of it was of poor quality ;

> On the draughtsman attempting to fill in, on the almost finished map of Rutnaghery collectorate, the larger divisions from Captain Jervis' Atlas of the Concan[4] [308–9], it was discovered that many of the divisions in the map were at variance with those in the Atlas, ... and that the positions of many places in the former were inaccurate. ... [He] recommends that Rutnaghery and Tanna collectorates be copied from Capt. Jervis' Atlas, the more correct and recent survey of the Concan. The plan of the Rutnaghery collectorate was copied from a map of South Concan prepared some years ago by Capt. Jervis [III, pl. 14]. To copy these two collectorates would take five months.
>
> The maps required by Government may be finished in 5 months...except the combined map, scale 15 miles to an inch, under preparation from different plans on various scales. Some original surveys require 8 months longer. The smallness of the scale does not permit the insertion of all the places.
>
> I find that the late D.S.G. had prepared a map of the whole Presidency on the...scale of 10 miles to an inch—one copy in Quartermaster-General's office—original with Commander-in-Chief—Have, therefore, relinquished the small scale map I had started, and am copying the Q.M.G.'s map.

He asked if there was a third copy "of this valuable map which could be conveniently spared", on which he could insert the remaining collectorates "in a couple of months". He hoped to be able to compile a quarter-inch map of the Ahmedābād collectorate in three months, after sending to the Collector a skeleton for the insertion of *pargana* and other interior boundaries[5].

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[1] DDn. 297(78), 1–6–37. [2] to SG., 22–8–33 ; DDn. 235 (87–90); *IO Cat.* ¼-inch degree sheets, Jopp, 1828–33. [3] CE. to BO Govt., BO RC., Camp 658/1835 (17–8). [4] *IO Cat.* (439–40), 1834, MS. 20. [5] BO RC., coll. 43/1836 (21–47), 23–6–36 *et seq.*

Besides the nine collectorates—Kaira—Surat & Broach—Khāndesh—Dhārwār—Ahmednagar—Ratnāgiri—Poona—Belgaum—United Presidency—the map would also cover Cutch, Kāthiāwār, and Rājpipla, for which maps of sorts were available [II, 169, 70 ; III, 127–9]. Government of India sanction had to be obtained to lithograph the 10-mile map in the Quartermaster-General's office. The map of Poona was held up for re-arrangement of the interior boundaries ;

> As regards the map of the several collectorates...united, ... upon which...the Head Draughtsman was to be employed, I regret...that, owing to severe indisposition of this exemplary young man for three months, the document upon which he has been so long employed is still far from being completed. ... Other duties...devolve upon Mr. White [III, 387] ; ... the due arrangement and preservation of so many plans and records, not only of this office, but those of the late Deputy Surveyor General and Revenue Surveyor of Guzerat [III, 170–1], and...custody and issue of the departmental stores[1].

The Quartermaster-General[2] was then instructed to arrange that,

> besides the complete maps...prepared on rollers for public departments, a number of additional copies of the separate sheets might...be usefully bound up with a small skeleton index map. ... Besides being generally useful to officers as an itinerary, they would form a very valuable book of maps for teaching local geography in the Native Education Society's [school] at Poona, and the better description of private English schools, and a...number might...be sold...to repay the cost of preparation[3].

The district maps were still uncompleted in 1838 when, writes Dickinson,

> such are the difficulties in...finishing the required maps of the...collectorates, each showing their respective talooks and neighbouring districts, that the originals...have...been upwards of two years under preparation, one only of the four now called for...having as yet been furnished.
>
> As these maps are, moreover, upon different scales, varying from 2 to 4 miles per inch, ... much too large for being conveniently...lithographed, I...suggest that, from...that on a scale of 10 miles to an inch...now being lithographed under Major Campbell's supervision, I should... prepare for being separately lithographed the required maps of the several collectorates[4].

The lithography of the 10-mile map was completed by March 1838, and copies were distributed to all district and departmental officers [III, 281][5].

In 1839 a storm which had long been brewing between Everest and Thomas Jervis came definitely to a head. Jervis had been pressing for acknowledgement of his surveys and maps of the Southern Konkan, which he had handed over to Jopp in 1830, and which had not yet been worked up into a useful general map. The Directors wrote from London that

> unforeseen difficulties prevented the completion of the map, ... and...we must now require the Surveyor General of India to undertake the...map for incorporation into the Atlas...as soon as possible. The original materials are...already in the possession of the Surveyor General, but to guard against delay...we now send all those furnished to us by Major Jervis[6].

The Surveyor General had in 1838 asked for all the material to be sent round to Calcutta, and De Penning reports the arrival of three cases containing

> maps, plans, and fieldbooks. ... No list whatever, nor letter of explanation, accompanied the contents, save a card stuck in the inside of the lid of each box, giving merely the numbers, amounting to upwards of 240 of maps, plans, and scraps, many of them having neither title, name, or scale, or any clue to guide us as to what part of the country the maps belong to. ...
>
> Several of these plans are in a shocking condition, torn into fragments, some of which are missing. ... Twenty-six plans in one case from one bundle, each plan torn into several pieces. Indeed many of these are mere...rubbish. The Assistant Commissary General's receipts, specifying only *3 Packages, contents unknown*, may be signed and returned[7].

A selection from this unpromising material was sent up for Everest's inspection ;

> Trigonometrical survey of part of the Southern Konkan, comprising the principal and secondary triangles in the Rygarh, Soowandroog, and Rajpoora districts, 1824–5 ; scale 5000 feet to an inch. ...
>
> Map of the Konkan, ... from Damaun to Goa, shewing...the respective states, ... and the intermixed possessions of the British and Native Powers, ... compiled from trigonometrical survey, measured routes, and native information, 1826. 2 miles to an inch.

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[1] from CE., 7–4–37 ; BO RC. 823/1837 (41–3).

[2] Charles Ovans [III, 493], relieved by Neil Campbell [III, 432].

[3] BO RC. 823/1837 (57–8).

[4] from CE., 26–2–38 ; Bo RC., 923/1838 (59–60).

[5] *IO Cat.* (416), lithd. by QMG., 1838 ; 2nd. edn. with roads by CE., 1842.

[6] CD to B., Mil., 16–10–39.

[7] from De Penning, 26–7–38 ; DDn. 352 (189–91).

A part of the Ghauts, north of the Koombar Pass. 2 miles to an inch. Unfinished copy.

Topographical survey of the northern part of the Southern Konkan districts of Kamala, Sanksee, Rajpooree, and Rygurh. Feb. 1829. 1 mile to an inch.

Trigonometrical survey of Ryegurh talooks. 5000 feet to an inch. The sheets joined irregularly and torn. Chart of triangles. 8 miles to an inch. Unfinished. in good order[1].

Like the Company's Geographer in London, Everest could make nothing of these disconnected scraps.

The survey...was commenced...when Major Jervis was a Lieutenant, in or prior to 1822-3 [III, 126]. ... The Surveyor General of the day was...not consulted. ... Though the operations...were apparently brought to a conclusion whilst I was Surveyor General, the records were not handed over to my office till 1837-8, on my express application. ...

Being desirous last year to make enquiry respecting the execution of this survey, I caused all the existing records to be sent to my office in the field, but I found them in so disjointed and confused a condition, and...an absence of anything like system pervading the whole, that I could make nothing of them whatever. ... If these be the original materials supposed...to be in my possession, the case will be a very hopeless one, and, ... as Major Jervis is now in India, it might be desirable to apply to him as the person most likely to be able to decipher his own materials[2] [362].

The maps sent out from London were compilations on two and four miles to the inch, without any lines of latitude or longitude[3]. These also were sent up to Everest, who was by no means impressed by them and, in sending them back to Calcutta, he agreed that they and other Bombay maps might be placed at the disposal of Jervis, who was permitted to visit Calcutta and take any material that might help him to compile a map of his own. Bedford was not happy about this, and insisted on Government authority ;

A variety of maps and books which Major Jervis was allowed to take with him to Bombay... are noted in the list herewith transmitted, and for...which I solicit the sanction of His Lordship in Council. ...

I had nothing to guide me...but a list made over by Major Jervis on the day of his departure, nor was there even time to compare this list with the maps and books for which I hold his receipts. ... It was only on my objecting to their being sent on board his vessel without due authority, that the note from Mr. Secretary Colvin...was obtained[4].

His apprehensions were justified, for, writes Wroughton five years later, many of the maps "have been entirely lost", and to retrieve the others "a voluminous correspondence took place"[5].

Jervis now set about compiling a map of western India in sheets stretching from Goa to Gujarāt, spending much time working out his own projection ;

I have myself investigated and computed the projection in detail of the precise divisions of the sheets, and the lines of latitude and longitude of that part of the Indian Atlas connected with this Presidency, a very difficult but necessary preliminary to laying down the surveys on a uniform scale [III, 293-6].

He had failed to get the services of any of the Chief Engineer's draughtsmen ;

A work of this great extent and manual labour necessarily requires some such aid, but with every possible desire to do justice to the confidence...of Government, I find it difficult to effect much with a single writer and two ordinary draughtsmen, whom I entertained in lieu of the second writer. ... I could accomplish twenty-fold with a few steady and efficient assistants, competent to the calculations as well as the drawing and printing[6].

The Chief Engineer was delighted at such an opportunity to pass responsibility for these maps to the "Provisional Surveyor General". He quite rightly pointed out that "the increasing and highly important engagements of the Chief Engineer" made it "most difficult to find time...for the supervisal of...maps and surveys"[7]. The proposal did not materialize. A few months later Jervis left the country for reasons of health [318], leaving unfinished his compilation

of the eight sheets of the Hon'ble Court's Atlas, the entire triangulation and a portion of the sketch of which I have laid down and adjusted...according to the...projection of the Atlas. ...

I...regret that such a work...should be abandoned, ... or that it...should...be eventually performed imperfectly or inaccurately. ... The tract...comprehends the four collectorates of

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[1] DDn. 354 (92–4), 16–12–39. [2] DDn. 402 (4–7), 25–2–40. [3] DDn. 411 (53–4), 21–3–40. [4] DDn. 408 (108–9), 23–12–40. [5] DSG. to Mil. Dept., 7–10–45 ; DDn. 470 (19–20). [6] BO RC. 1321/1841 (159–62), 24–8–41. [7] from CE. 30–6–41 ; BO RC. 1321/1841 (167–79).

> the Deccan, the Surat collectorate, the North and South Konkan, the Satarah Rajah's, the Kolhapur Rajah's and Swant Waree territory, and the southern Maharatta collectorates of Belgaum and Dharwar, besides the contiguous frontier territories of His Highness the Nizam, the Portuguese possessions, and part of the Madras dependencies of Soonda and Ceded Districts. ...
>
> I should be happy...to direct the completion of the work if the Government would authorize Hyam Essajee, Assistant Surveyor and Draftsman [III, 393 ; IV, 242], to proceed with me to England. His salary in garrison is 100 rupees in the field 140 rupees—per mensem, and he is the best of this class of native assistants. It will enable Mr. Walker, with whom the engraving and publication of the sheets...rests, to proceed with them with...expedition and confidence[1].

It was well for the survey of India that Jervis's facile optimism, and supreme self-confidence, made no impression on Everest's solid professional soundness, and penetrating critical acumen. The triangulation on which Jervis so light-heartedly wished to tie the heterogeneous surveys of the Presidency was never of the class to carry such surveys over such an extent of country. The Directors had already declared that their Atlas should have no other foundation than the principal triangles of the Great Trigonometrical Survey [303] and Everest had no intention of lowering the standard of his survey to please anyone. His estimate of the unreliable character of Jervis's work in the South Konkan shocked the Directors ;

> We cannot but express our surprise at the opinion given by the Surveyor General on the Konkan Survey...which occupied Major Jervis for upwards of ten years. ... We regret... that Lieutenant Colonel Everest has...found the records...in an unsatisfactory state. ...
>
> We expect our surveyors to perform their work on an approved and well-understood system, so that at any stage...the survey may be intelligible to a qualified surveyor, ... and so as not to render necessary at any future period a reference to the surveyor himself to "decipher"...his own materials before they can be fit for publication [92, 293].
>
> If the case were otherwise, the death or retirement of an officer...might render necessary the recommencement of the whole work[2].

Neither Everest nor Waugh would have anything to do with the compilation that Jervis had started until, after the computation of the Bombay triangulation, Waugh made another attempt, and recovered the six essential sheets from the Military Secretary's office ; "I have very little hope of success, and would not attempt it if I had not the advantage of additional materials from the recent operations of the Bombay Trigonometrical survey"[3].

In 1849, after all the necessary triangles had been computed[4] the Surveyor General forwarded the maps to Calcutta for compilation[5], commenting that

> the discrepancies...on comparison with the G.T. Survey points, though not very large, are...in most instances of a nature to render necessary an alteration in the topographical map. ... The Memorandum of Instructions...will form a sufficient guide and caution in this extremely delicate operation of reducing original materials so as to disperse discordancies. The work will need to be put into the hands of a clever and scrupulous draftsman. ...
>
> Some points of the same name in Lt. Rivers' and Major Jervis' maps are not identical, the former referring to hill stations, the latter to village sites[6].

A year later Thuillier reported that the adjustment was giving great trouble and might yet take another two years ; the component slips were "all longitudinal and narrow", and "did not precisely accord ; ... the variation in latitude and longitude is not constant, but very irregular on all the sheets"[7]. In 1851 the Surveyor General informed the Chief Engineer at Bombay that after considerable difficulty the maps had at last been compiled, and might soon appear in print ; "the old degree maps of the Deccan, though incomplete, will perhaps serve for present purposes"[8] [III, 284 ; IV, 306]. Waugh records that

> the materials were sent by my predecessor to Major Jervis himself to put in order, but they were returned to my office in 1845 in the same state precisely as before. I was then in the field, and being desirous to provide for the Atlas sheets without...the great expense of a re-survey, I sent for these materials for...comparison with Lieut. Rivers' triangulation.

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[1] BO RC. 1321/1841 (731–5). [2] CD to B., Mil., 21–12–41 (20–2). [3] DDn. 414 (132–4), 1–5–45. [4] including Konkan Merdl. Series. [5] for Atlas sheets Nos. 24–7 [pl. 23]. [6] DDn. 561 (66), 25–8–49. [7] DDn. 474 (278), 27–4–50. [8] DDn. 543 (65) ; 13–10–31.

> The materials for sheets 39, 40, and 41 [III, pl. 24]...were borrowed by Major Jervis in...1840, ... and taken by him to Bombay, where they were deposited in the Chief Engineer's office, and have been detained there ever since[1].

After this lapse of more than twenty years Rivers found it impossible to identify the stations of Jervis's triangulation, but it was possibly unfair to suggest that "some of his surveyors' angle books were written up in a tent, for hills were put down visible which were not [so] in the field"[2].

ORTHOGRAPHY

It was natural that Everest, with his trained, precise, mind, should have been exacting in his desire for uniform spelling in the maps and charts prepared under his direction. The popular systems of Jones and Gilchrist [I: 249-50] had their several advocates, but neither provided any panacea for all names that might find their way on to a map. They merely prescribed rules for transliterating Indian spelling into an English equivalent. They could not guarantee the correct recording of the true Indian name, nor its true pronunciation. Henry Prinsep[3], distinguished member of a talented family, has commented on the pitfalls to be met.

> Revenue surveys were put in hand, and maps on a large scale were constructed, in which the names of every place or object were accurately entered according to the same system (viz., Gilchrist's, modified). Up to this time no attempt had ever been made to make this grand improvement in the geography of India.
>
> The maps of Bengal were copied...from the surveys of Rennell, made in the era of jargon, and though better spelt than most...documents of that period, yet...liable to mislead. ... Surveyors...had been left to pick up the names of places by the ear, and it had never been...an instruction...to ascertain how they were written in any...language of India, and to transfer them according to system into their maps. The surveyors too...were very seldom scholars.
>
> In order to...expose at once the absurdity of trusting to the ear in a matter of this kind, an extract is annexed from a map of the Dooab, compiled...not ten years ago. ... It bears the official signature of the Surveyor General of the day, and professes to be from the best materials then in the archives of that department. ... It will be seen that the well known road from Cawnpoor (Kahnpoor) to Ukburpoor is laid down double, being taken apparently from two routes made with compasses or theodolites, varying in a small degree, so as to give a different direction, and the copyists...have not discovered that the routes are the same *because all the names are spelt differently*. There are...

Kuttra	...	Gittera	Fattipr	...	Futtehpr
Chichehree	...	Chichindy	Reneea	...	Runneah
Bhysour	...	Bhysawn ; Bheisawn,	Oomrun	...	Oomeron

> with sundry other names, till one road comes to Akberpoor, and the other to Akbarpoor[4], the relative distances of all these places being the same.
>
> Like absurdities might be shown in many maps similarly constructed from materials in which the names have been set down by the ear without the observance of any system of spelling. ... The Revenue Surveys, so far as they went, effectually corrected this error ; and... the maps...are capable of being converted with confidence into any character, ... whenever it is desired to publish a map in the Persian, the Hindee, or in any other character[5].

Everest ruled that his topographical surveyors should "adhere undeviatingly ...to the orthography of the names...from the Great Trigonometrical Survey".

> I have thought it best to follow...Sir William Jones...and, though I do not commit myself to any existing system as being faultless, ... yet I have strenuously patronized the introduction of...Italian vowels with English consonants into the orthography of all maps, and in those of the Great Trigonometrical Survey...have effectually succeeded in attaining this end[6].

He asked for Bedford's help

> in eradicating every vestige of the barbarous mode of Dr. Gilchrist. ... The [best] system is simply to use Italian vowels, which have the most definite intonation of all known languages, to the utter eradication of those of our own mother tongue, which...present the most entire variance between orthography and pronunciation of any dialect that I am acquainted with. ...

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[1] DDn. 462 (331-2), 13-6-49. [2] DDn. 592 (357), 6-11-55. [3] Henry Thoby Prinsep (1792-1878); BCS. Sec. Ter. Dept., 1826-34 ; Ch. Sec. 1834 ; Member of Council, 1835-43 ; *DNB.* ; *DIB.* [4] 25 m. SE. of Fyzābād. [5] *JASB.* II, 1834 (285-6) ; DDn. 303 (549), June 1834. [6] Everest (70).

> No person who understands Italian can be at a loss, and those who have not that advantage are ashamed to make a public avowal of their ignorance, and therefore, forbear to indulge in a laugh at the hardness of the names, because such laugh would rebut on themselves[1].

Brought up under the revenue survey system, Bedford pleaded guilty to

> the barbarous charge of being a decided supporter of Gilchrist's method. ... I was so unfortunate as to study the eastern languages in the college of Fort William [I : 250] when the worthy Doctor was quite the fashion, and habit...has...become too inveterate...to be eradicated. With an intimate knowledge of the French language, however, and some little of the Italian also, I hope to find no difficulty in carrying into effect any orders you may convey. ...
>
> In the Drawing Department the names have, I understand, always been copied in strict conformity with the original orthography, and must, I conclude, so continue to be[2].

Markham records that Michael Crow, Deputy Collector of the Calcutta suburbs [192], compiled a treatise on orthography, presumably of Bengali names[3].

In Bombay the Chief Engineer, Thomas Dickinson [III, 439], directed that

> in the compilation of any fresh maps...of this Presidency...no endeavours [should] be spared for the correction of the names of towns and villages, no two surveyors spelling many of them alike ; an evil which is still further increased by the...errors of copyists, and those omissions and imperfections in their lithography which renders many letters...obscure. ... A close adherence to the Sanscrit or the Devanagri pronunciation and orthography...should perhaps be observed[4].

LITHOGRAPHY

Although the Surveyor General had as yet no lithographic press attached to his office, he could, with the previous sanction of Government in each case, have maps printed at the Government Press run by Dr. James Rind, or at the private "Oriental Lithographic Press" belonging to Jean-Baptiste Tassin [III, 298–9].

When Tassin was asked to lithograph "the map of the Indus River and of the Neighbouring Countries" [292–3], he gave an estimate of the cost ;

		Rs.	Rs.
To copying the Indus map on drawing paper	600		
To copying the Indus map on stone	900		
Charge for printing 100 copies on six stones @ Rs. 5 each ...	30	930	
Cost of 100 lithographed copies			930
„ 200 „ „			960
„ 300 „ „			990
„ 400 „ „			1020
„ 500 „ „			1050[5]

> Government to furnish the drawing paper on which the lithographic impressions are to be struck off. ... Copies will be coloured...without charge. ... Lithographed copies will be ready 3 to 3½ months from the day the map is delivered into Mr. Tassin's hands[6].

The map was on sale, and Graham informs the Surveyor General that

> having seen an advertisement in the newspaper on the 26th inst. by Mr. Tassin, offering...the lithographed Indus map for sale at Rs. 25, ... and none having been sent to our office from the Political Department, I waited on Mr. Trevelyan [402] to procure 2 or 3 copies for despatch to you as well as an office copy[7].

Another map that went to Tassin was Everest's map of "the country between Orenburg and Kandahar" [293]—"one hundred copies...at the estimated cost of Rs. 510"[8]. This Tassin promised to execute

> on stone as soon as possible in my best style, and print it...at the agreed charge. ... Concerning all the maps which I may receive from Government, ... I will, as I always did, consider it a sacred duty not to strike any more copies than the number required by my employers[9].

Some weeks later Everest asked De Penning how the work was progressing ;

> I fear it will be too late now to make any alterations in the compilation map on the stone, but, if the copies have not all been transferred, I could certainly desire the more recent data by Kootouzoff to be introduced instead of...Mouraviev's route. ...

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[1] DDn. 354 (13–6), 12–3–39. [2] DDn. 354 (20–1), 26–3–39. [3] Markham (388). [4] BO RC. 13 1/1841 (167–69), 30–6–41. [5] Note the very small increase for extra copies. [6] DDn. 297 (8), 5–5–34. [7] DDn. 315 (5–6), 30–1–35. [8] the same estimate offered 200 copies for Rs. 520 and 50 for Rs. 500. [9] DDn. 284 (208), 13–11–32.

> Ascertain from Mr. Tassin at what price the copies ought to be disposed of, so as to cover the expence. ... You will then...wait on Mr. Swinton and learn whether it is the pleasure of Government that the copies should be sold at the said remunerating price. ... I have applications from gentlemen here [Mirzāpur] to be supplied, paying for the same[1].

to which De Penning replied that

> Mr. Tassin has not made any great progress in the map owing to an accident that occurred to his press, which...went to pieces from too great a pressure. He has, however, got the upper half on a stone ready for striking off, and Mr. Graham has furnished...as much of Koutouzoff's data as could be admitted. A proof sheet will be forwarded as soon as impression is made, as also 5 copies of the plan for the use of your office.
>
> With respect to the price, ... Mr. Tassin can give no information. That will rest with the Secretary, Mr. McNaghten, [213 n.3] in the room of Mr. Swinton who has retired[2].

Amongst many other maps published by Tassin were ;

> *Map of the City and Environs of Calcutta,* constructed chiefly from Major Schalch's map, and Capt. Prinsep's surveys of the Suburbs, with the latest improvements and topographical details by J. B. Tassin. Calcutta. 1832. Scale 4½ inches to a mile [III, 13][3].
>
> *Map of the Post Office Stations* and Post and Bangy routes throughout British India, ... from materials collected and arranged by Captain T. M. Taylor [III, 500]...for the use of the Post Office Department of the three Presidencies ; Scale 90 miles to one inch[4].
>
> *Tassin's Atlas of the Ganges.* 1835. Map of the Rivers Hooghly, Bhagruttee, Jellinghee, Ganges, and Jumna, from Calcutta to the Himalaya Range. Compiled from the most accurate surveys. ... On 7 sheets with an index map[5]. In bound volume 13½ inches by 20 ; Scale 10 miles to 1½ inches. ...
>
> *Tassin's Atlas of the Delta,* 1840. Inland Navigation in Eastern India. Chart delineating the river navigation to Assam from the Presidency by the Soondurbun Passage, as well as by the Jellinghee and Mathabhanga Rivers ; also to Chittagong, Dacca, Mymensing, and Silhet. ... Lithographed by order of Government and published with an indexed map. ... Calcutta 1840. Scale 4 miles to an inch. One volume, large qto[6].
>
> *Map of Eastern Asia,* comprising China, parts of Tibet and Mongolia, Bootan, Assam, Burma, and Eastern Bengal. ... by J. B. Tassin, 1840. Scale about 104 miles to inch.
>
> *Map of North West Frontier of British India,* J. B. Tassin. 22 miles to an inch. 1838. Price Rs. 16 a copy [293].
>
> *A New and Improved Map of the Provinces of Bengal and Behar.* ... Scale 8 miles to an inch. 1841 [286][7].
>
> *Map of Singapore.* Drawn by J. B. Tassin from actual survey by G. D. Coleman. 6 inches to a mile[8].

The map work of the Government Press was defective, "even in everyday plans";

> The productions of that press, instead of improving, as might reasonably be expected with time and practice, have gradually deteriorated. ... The defects...are that the lines of routes, instead of being clear, are jagged and broken—that the lines marking the meridians and parallels...are in some places of an enormous thickness, and in other almost obliterated—that in many instances the names...are smudged, in others the hair strokes are too thick, in others again the letters are faint as shadows—that the courses of rivers are delineated in the rudest manner by rigid lines instead of...graceful curves. In many cases these lines too are smudged, the others blotted, and in other the fine strong lines...run into each other.
>
> I have long had reason to be dissatisfied with the productions, ... but I had hoped the defects would have been remedied without my troubling you on the subject. ... I am really quite ashamed to allow plans so badly executed to issue from my office bearing my signature. ... The blame does not lie with me, for the drawing on the transfer paper was entrusted to a capable draftsman, and appears to me to be a very neat performance[9].

Dr. Rind, Superintendent of the Press, received these strictures "with the deepest regret", but blamed the transfer drawings received from the Survey office, and though anxious for better results doubted whether

> highly finished drawings could be expected from a native upon 16 rupees per mensem. ... I might...have applied for Mr. Tassin's services, ... but I was unwilling to incur the expense. I would...suggest...employing him in any future works of the kind, the more especially as his great quickness in drawing enables him to make his terms extremely moderate. The late-lamented Captain Prinsep [III, 405–6] often declared to me that he never in India met with a man who drew maps so rapidly or so well as Mr. Tassin[10].

Not only did Government refuse to sanction the employment of Tassin, but they refused the Surveyor General's request to start a press of his own[11] [339]. The Directors indeed thought the Government Press was doing useful work apart from the printing of maps, and suggested that it might take in work from "the mercantile community of Calcutta"[12].

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[1] DDn. 316 (25–7), 1–2–33. [2] DDn. 303 (35), 12–2–33. [3] VM. exbt. 1732 ; *IO Cat.* (191). [4] *IO Cat.* (87). [5] MRIO., Misc., 6–0–35. [6] *IO Cat.* (100). [7] *IO Cat.* (169). [8] Geo. Drumgold Coleman ; survr. & engr. ; bur. Singapore, 27–3–44, aged 48. [9] from SG. ; DDn. 283 (160–1), 28–9–32. [10] DDn. 281 (69–76), 17–10–32. [11] DDn. 282 (222), 31–12–32. [12] CD to B. Pub., 1–4–35 (1–3).

In 1840 Dr. Rind was given leave on medical certificate and died at sea. In appointing Arthur Sanders of the Quartermaster-General's staff to relieve him, the Governor General noted that, as the "difficult and delicate work" of the map branch is "exceedingly defective, ... I have authorized Lieut. Sanders to apply the Rs. 200 monthly, which will be saved from Dr. Rind's salary, to its improvement[1]".

The work of the press was now split into two parts :

> The copying of papers and forms to be attached to the office of the Superintendent of Stationery, and to come under the...Military Board. ... The map and drawing branch...to be transferred to the Surveyor General's Department, and to be conducted by Lieutenant A. Sanders, with a salary...of 100 rupees a month. These arrangements will leave 200 rupees a month, besides the 200...ordered...to the improvement of the map department[2].

When he first took over charge Sanders hesitated to

> tell beforehand the time and labor necessary to make a copy on transfer paper of a complicated or extensive drawing. ... The rainy season is the very worst time in every point of view for lithographic work, and should the maps be now executed, a double copy of a drawing might be necessary, which would of course very much increase the expense. ...
>
> As the multiplication of maps by lithography is (in addition to its correctness and rapidity) more cheap than by hand, if three copies are required, the chances of accident may not be worth taking into consideration[3].

The demand for geographical and revenue maps was never ending :

> The establishment...is too inefficient to admit of...work being promptly executed and, besides the map of Afghanistan, of the district of Jynteea, and several hundred Chittagong plans [209], ... there are a great number of pergunnah maps of which copies are required. ... The present limited means of the Government Lithographic Press presents the sole obstacle to... multiplying the existing want of maps[4].

Machines and stones had to come from England, though Shortrede reported from the Karara Series in Mirzāpur that he had found a sandstone that might be used. Specimens were sent down to Calcutta, and a pensioned assistant, C. H. Burke [397], spent some months in further search[5] without success.

In 1841 the Board of Revenue at Allahābād, having established a press of their own [288][6], called on Stephen who was closing his surveys at Hamīrpur [227] to prepare his own district maps for transfer to stone, and sent him

> six sheets of lithographic paper and lithographic ink. You are to write on the paper precisely as you would on drawing paper, merely observing the following precautions ; the ink is to be rubbed up every time it is used with warm water in the same manner as Indian Ink, to the thickest consistence...possible to write with. This must be particularly attended to, as of course the draftsman is anxious to dilute it as much as possible to save time and trouble. ...
>
> The parts written should be lightly covered with paper, and carefully kept from being rubbed, and from grease and stains, as the ink being of a greasy nature never dries properly, and would come off if rubbed with a cloth or any rough substance[7].

Thomas Jervis was a keen lithographer. After his retirement he started a private press of his own in England, and did important work in producing maps of the Crimea for the war of 1854. Of the press in Bombay he writes that, before 1840,

> my brother, Colonel George Jervis, now Chief Engineer, conducted the newly formed lithographic press [III, 384]. ... There was one desideratum, however, we could not accomplish (and indeed, the same remark applies to all other presses throughout India, not excepting...Calcutta), viz., maps and pictorial illustrations. ... They could not be done for want of Artists; often for lack of materials...and funds. ... Officers of the staff and engineers alone understood the subject[8].

And, he might have added, Jean-Baptiste Tassin.

[1] GG.'s minute; 28-5-40; BRC. 8/6-40. [2] BGC., 17-6-40 (16). [3] DDn. 390 (83-4), 20-6-40. [4] from DSG., DDn. 408 (144, 151-2), 14-4-& 3-5-41. [5] *JASB.* XIII, 1844 (xxix, e c.). [6] one machine tr. from Govt. Litho. Press, Calcutta. [7] DLR. 37/53 (152), 6-8-41. [8] *Jervis* (171).

CHAPTER XIX

ADMINISTRATION

Surveyor General & Superintendent Great Trigonometrical Survey — Deputy Surveyor General; Revenue Surveys — Allahābād 1830–37 — Calcutta, 1838–42 — Assistant Surveyor General, 1838–42 — Deputy Surveyors General, Bombay & Madras, 1830–33 — Accounts.

THE following is a list of Surveyor Generals and Superintendents of Trigonometrical Survey who held office before 1830 [I : 260–1, 265 ; II, 295, 299, 305–6 ; III, 300–1, 307–8].

Bengal		*Madras*	
James Rennell	1767–77	Colin Mackenzie	1810–15
Thomas Call	1777–86		
Mark Wood	1786–88	*India*	
Alexander Kyd	1788–94	Colin Mackenzie	1815–21
Robert Colebrooke	1794–1808	John Hodgson	1821–23
John Garstin	1808–13	Valentine Blacker	1823–26
Charles Crawford	1813–15	John Hodgson	1826–29
		Henry Walpole	1829–30
Bombay		*Trigonometrical Survey*	
Charles Reynolds	1796–1807	William Lambton	1800–23
Monier Williams	1807–15	George Everest	1823–25

Everest sailed from India on sick leave on 11th November 1825[1]. Whilst in England he was, on 25th August 1829 [III, 301], nominated by the Court of Directors to be Surveyor General and Superintendent of the Great Trigonometrical Survey, the first officer to hold these two important posts simultaneously. To facilitate his valuable work collecting new instruments and visiting scientific surveys, he was put on special duty during 1827. Several extensions of leave, six months at a time, were granted on account of health, but in sanctioning a final extension the Directors warned him that it was essential that he should reach his presidency, Bengal, before the expiry of five years absence[2]. Sailing from England in June 1830 he reached Calcutta on 6th October, and took over office as Surveyor General on the 8th, holding it without interruption till December 1843[3].

When Herbert, the Deputy Surveyor General, was appointed Astronomer at Lucknow in December 1831, his duties as Superintendent of Revenue Surveys fell on the Surveyor General until Bedford's appointment six months later [320]. Bedford's office was then moved to Allahābād, and on his own move in December 1832 [4, 24] Everest left De Penning, Graham, and Barrow in charge of the computing and drawing offices and the instrument repair workshop respectively. Whilst he himself visited his surveyors in the field, travelling via Mirzāpur, Saugor, Gwalior, and Agra, his field office travelled up by river under charge of the Registrar, and joined him in Mussoorie in May 1833 [172][4]. Everest then made his personal headquarters at Mussoorie till September 1843 [112, 163], his official field office moving to Dehra Dūn in January 1834 [165–6].

Whilst devoting all his energy to the prosecution of the Great Arc, he kept close control of everything to do with the Great Trigonometrical Survey—the field parties, including that in the Bombay Deccan—the instruments and the computing

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[1] CD. Misc., 68 (2837) ; Com Corr., 19–5–30. [2] CD. Misc., 1092, 1108, 8–& 20–5–30. [3] DDn. 265 (61) 8–10–30. [4] DDn. 283 (199–201), 15–11–32 ; BMC. 19–11–32 (100).

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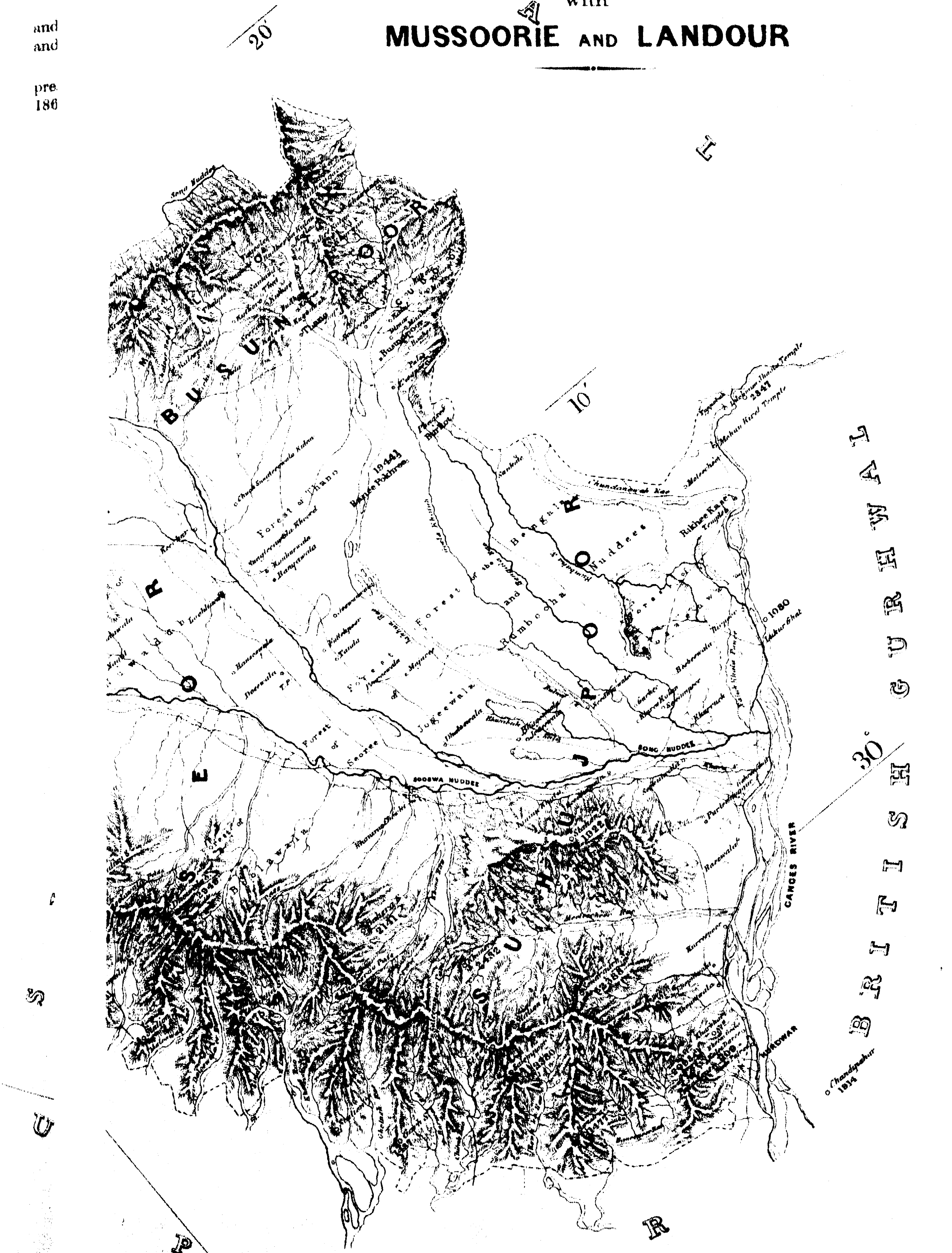

office at Calcutta. He gave little time or attention to topographical and geographical surveys, and left the revenue survey entirely to his Deputy [323]. His correspondence with the Military Department of the Government of India [97] was heavy and steadily increased and, whilst his own letters and reports ran to great length, he continually urged his officers to keep their references to him to an absolute minimum [344]. Of his own dual post he writes;

> There was not at my disposal a single individual on whom I could rely for...efficient aid. ... This difficulty was enhanced by...my now holding two situations. ... That of Surveyor General called for my constant presence in office to conduct all the business and correspondence relating to the Geographical Department. ... The other, Superintendent of the G.T.S., required me to be perpetually in the field, to instruct...and to take an active part in observing[1] [343].

Early in 1835, during the measurement of the Dehra Dūn base-line, Everest was taken seriously ill. He was confined to bed for two weeks in February, and again "from May to the end of October with little intermission". Receiving an order that, in the event of his having to take sick leave, he should hand over to the senior officer present, he replied that

> there is no officer at my headquarters. All are busily employed in the field, and I cannot withdraw any of them without putting a stop to some part or other of the operations. I... forward a list of all the officers under my orders...that the Hon'ble the Governor General in Council will select any one of them...to receive charge of the public property. ...
>
> Though it is not my intention, whilst any chance of my recovery remains, to quit the operations of the Great Arc, yet I...forward a medical statement...by Dr. Gray, from which it will be clearly seen that the labour is too much for me, ... that I run great risk, and so say the other medical gentlemen—Be it so—I am willing to run such a risk—but I hope it will be left discretionary with me to return to the Presidency as soon as I feel that I can no longer remain with safety. ...
>
> The climate of Calcutta [319], ... bad enough, never disagreed with me so much as that of the Upper Provinces, and perhaps on my arrival there I may continue to perform the duties of my situation without...a voyage to sea. Next to my carrying on the work myself, my being able to direct...the operations is the most likely to forward...the Great Arc to a satisfactory conclusion, and though the former should be impossible, the latter may be perfectly practicable. I certainly have no intention of proceeding to sea whilst there is a possibility of avoiding it[2]

He was authorized to bring Waugh in to headquarters to take over charge if it became necessary, but "in the unfortunate event of your unavoidable absence the expediency of continuing...the Great Arc will be taken into consideration". Though he soon regained his wonted vigour on the return of the cold weather and the resumption of active field work, he was glad to have Waugh with him [39].

After Lord Auckland's arrival as Governor General in 1836, correspondence increased and interfered greatly with Everest's field operations and other professional work, whilst the new Governor General fretted at the continued absence of his Surveyor General from the Presidency, and at the great delay of professional advice and reports [297-8]. Although Everest submitted a full and lengthy progress report in August 1836 [110], he was pressed for another the following year. This he delayed as he was fully occupied with computations and office routine, and was so ill on his march down to Sironj after the rains of 1837 that he could take no part the remeasurement of the base-line. Receiving a peremptory reminder, he wrote a lengthy apology;

> I did not myself quit the field until the month of May [1837] was somewhat advanced, and then I arrived at headquarters jaded to death by the night work of the observatory at Kaliana. Moreover, the current business and money matters of the office had on that account fallen into arrears, which it was my first duty to bring up, and lastly my parties...under Lieutenant Waugh did not arrive at my headquarters until near the middle of...June [41].
>
> The question then...was not as to the propriety of drawing up...the report, ... but as to which business was first to be attended to, the computations or the report. I decided that the former was, and, as I could not do both simultaneously without a reasonable prospect of spoiling both, ... the report was postponed. ...

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[1] *Meridional Arc.* (v, x).

[2] DDn. 286 (223-6), 31-10-35.

> The mass of computations was, however, too great to be got through in the short space between the middle of June and the middle of September, and...much remains to be done to its completion. ... I was again in the field...on the 1st October. ... I am really very much concerned that I should...have disappointed...His Lordship, but...the moment I return to my headquarters, I will proceed to take the desired report in hand, and make it as full and informatory as I possibly can. ...
>
> I beg to draw...attention...to the difference between my Department as it at present stands and as it stood in 1822 [344]. There were then
>
> 1 Surveyor General of India at Calcutta
> 1 Superintendent of the G.T.S. of India
> 1 Chief Assistant to the ,, ,,
> 1 Deputy Surveyor General[1] at Calcutta
> 1 ,, ,, ,, at Madras
> 1 ,, ,, ,, at Bombay
>
> The Surveyor General was constantly at headquarters, and though he drew a higher salary than I do[2], yet he never took the field, or stirred from home. The Deputy Surveyor General was also constantly at headquarters ready to aid his superior.
>
> The business of the other two presidencies was managed each by its own Deputy with an efficient establishment, ... and neither took the field. ...
>
> The Superintendent of the Great Trigonometrical Survey rarely, if ever, took the field, and never in triangulation [III, 223, 237][3]. His Chief Assistant, your obedient servant, was the fag of the G.T. Survey...and perpetually in the field[4]. ...
>
> [in contrast there are now]
>
> 1 Surveyor General—who is also Superintendent of the G.T. Survey, who was once told in a letter from your office in 1833 that he is expected to be always in the field, and who generally has been so for 8 months of the twelve.
>
> 1 nominal Deputy Surveyor General of Bengal—who has been from the time of his nomination absent from his superior, and has never afforded him one atom of assistance, or ever done one hour's duty in that station [320–3].
>
> No Deputy Surveyor General at either of the other presidencies—at which the control of every survey in progress has been thrown into the mass of duty which overwhelms the office on the Bengal side of India [327–8].
>
> There is, it is true, an astronomical assistant of the G.T. Survey—who renders as much assistance to me as I...rendered to my superior—but with this difference, that he and I are fellow labourers in fatigue as in other duties, and between us we do double the quantity of work which would otherwise be accomplished by either. But Lieutenant Waugh takes no part of the duty of the Surveyor General's office. ...
>
> All my other officers, Lieuts. Boileau, Renny, and Jones, each have their own...business to attend to ; are neither of them permanently at headquarters, and have never rendered me the slightest shadow of assistance in...my office business. ...
>
> The office of the Surveyor General must fall into arrears, and—when one man is thus called on to execute duties for which five persons...were not deemed too many—...the marvel is, not that such a result should take place, but that it should so long have been...warded off.
>
> I scarcely know how to describe the drudgery to which I have been subject. ... There are as yet few arrears of office, and though in some...instances business has been omitted, ... yet those instances have been marvellously few. ... Even now I am transgressing the rules laid down for me by my medical adviser, at the risk of incurring a relapse, for quiet and repose have been prescribed for me as the only chance of recovery from my late illness[5].

During his illness at Sironj Everest had left the measurement of the base-line to Waugh, his Astronomical Assistant, and when Waugh marched south to Bīdar [41–2], Everest marched back to rejoin Barrow and the astronomical circles at Kaliāna, and again insisted that he could no longer carry on his office work unaided ;

> My late illness at Sironj has convinced me that I shall no longer be able to endure that incessant toil of body and mind which I have submitted to in silence for the last 5½ years.
>
> I have partially succeeded...in carrying on that duty formerly allotted to six persons, and... believe that I have left nothing to be desired. But the mental and the corporeal exertion... has at length born me down, and reduced me to the brink of the grave. ...
>
> There is a vast deal of computation now in my office which...is my first and most imperative duty, ... and this will require my constant superintendence for the next six months. During that period I can give but a very partial attendance even to the current business of my office, and shall be utterly unable to draw up the Report called for, ... unless the Deputy Surveyor

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[1] Not correct ; Herbert was ASG. in 1822, and the assts. at Madras & Bombay became Deputies in 1823. [2] but drew 1500 only v. II, 325 ; cf. III, 346 ; IV, 328. [3] Lambton aged over 62 when Everest joined, 1818. [4] but on sick leave 18 months, 1820–2 [III, 232–3]. [5] DDn. 342 (78–82), 29–12–37.

> General, who is, I am informed, an able man of business, receive orders to...join my headquarters at Dehra. ... The presence of an able Deputy is absolutely indispensable to...the current business of my Department[1] [343].

The following month he met the Governor General at Sahāranpur, and explained that it would require "two to three years to finish his measurement of the Great Arc, and it is then his intention to return home". Producing a medical report which emphasized his need for rest, he assured "His Lordship...that, while so interesting a work as the Great Arc of India is in question, I have no desire to avail myself of this certificate, or to shun any reasonable toil and exposure"[2]. He pressed for an able officer to assist with the work at headquarters[3].

Bedford was directed to take over charge of the Calcutta offices from October 1838, in addition to the revenue surveys [325], and thus become Deputy in actual practice as well as by designation. The appointment of an Assistant for charge of the field office at Dehra Dūn was also sanctioned [326–7]. Everest gradually threw more work on to his Deputy, and in 1840 he directed that, as the

> accumulation of computations connected with...the Great Arc and subordinate meridians, and ...arrangements for their further prosecution, ... leave me no time whatever to attend to the topographical surveys...under the Madras Presidency, ... I am instructing the officers in charge of the Hyderabad, Salem, and Nellore surveys to put themselves in communication with you. ... I have...given instructions that all documents connected with those surveys be made over to you ; ... you will...attend to them, referring...to me when...absolutely necessary[4] [248, 325].

Early in 1838, possibly when he met the Governor General, Everest learnt that the Directors, as a consequence of his serious illness of 1835, had taken the precaution of nominating his successor. Their selection was a curious one, Thomas Jervis of the Bombay Engineers being appointed "Surveyor General of India provisionally, on the resignation, death, or coming away of Major Everest [11]"[5].

Jervis' survey of South Konkan between 1822 and 1830 had not been of a high order of accuracy [III, 126–7 ; IV, 308], but he was ambitious and a good showman, and had produced well-finished maps that had greatly impressed the uncritical members of the Bombay Government and, what is more surprising, the scientists of the Royal Society in England, and through them the responsible authorities at India House. Jervis had made his opportunities whilst on furlough, 1836–7, at a time when the Directors were anxious about Everest's health and the possibility of his having to leave India.

Fortified by this official appointment, Jervis gave a lecture to the British Association[6] in which he gave an account of the surveys already carried out in India, and indicated the lines on which future work might be extended under his own direction. The scientific societies of London were so much impressed that they submitted a combined address to the Court of Directors, signed by "the Presidents, Vice-Presidents, and Fellows of the Royal Society, the Geological Society, and the Royal Geographical Society", in which they elaborated these proposals. Jervis had his lecture and the address, and several letters, printed for private circulation, and sent a copy to Everest, who was indignant at the presumption with which his successor-designate had announced his programme, as it were over his dead body. He retorted by writing "*A Series of Letters addressed to His Royal Highness the Duke of Sussex*", President of the Royal Society[7], in which he scoffed at the proposals, and made a stout defence of the conduct of the work under his own direction. These letters appear to have been written at intervals during 1839, and were published in London at the end of that year.

Finding after his return to India that Everest's health was thoroughly reestablished, and that he showed no signs of early resignation, Jervis applied through the Bombay Government to be given charge of all surveys in Madras and Bombay, a suggestion that was rejected by the Governor General and the Directors ;

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[1] DDn. 342 (111–2), 12–2–38. [2] ib. (202–13), 11–6–38. [3] minute by GG., 16–3–38 ; BRC. 13–11–38 (28). [4] to DSG., DDn. 410 (51–2), 20–4–40. [5] CD to B., Mil., 20–9–37. [6] 26–8–38 ; Thos. Jervis [xviii]. [7] Everest [xvi].

> We entirely approve of your refusal to comply with Major Jervis' request to be appointed Deputy Surveyor General for Southern India, with Belgaum for his headquarters.
>
> We cannot allow of any organic change in the system of carrying on the Trigonometrical Survey under the personal superintendence of the Surveyor General in the field, or of any material alteration in the system by which the other duties of the Surveyor General are limited to geographical and topographical delineations. ...
>
> Should Lieutenant Colonel Everest resign his office and be succeeded by Major Jervis, we desire that it may be distinctly understood that...he will be both willing and able to follow out and adhere to the present established system[1].

Learning from Everest of his determination not to leave India before the Great Arc was completed to his entire satisfaction [11, 317], Jervis resigned himself to the inevitable, and left India at the end of 1841.

An account has been given elsewhere of the non-professional Survey Committee which the Governor General set up in Calcutta with a view to control the programme of geographical mapping that Lord Auckland was anxious to push forward, regardless of the Directors' orders on the subject of the quarter-inch Atlas, and the Surveyor General's responsibility [297, 302]. Another order—not endorsed by the Directors[2]—provided that as soon as Everest had completed the Great Arc he should transfer his headquarters to Calcutta, and that the next Surveyor General should entrust the field-work of the Great Trigonometrical Survey to a junior officer, and make his own headquarters at the Presidency as professional adviser to Government [21, 298–9]. Everest had no desire for life in Calcutta [315, 319];

> There is no method of getting...good work from any establishment so sure as by keeping all members of it in good health. ... Some men's constitutions are peculiar, and the climate of Calcutta may suit them, but considering that the peculiarities of talent...and disposition are more essential to ...a Surveyor General than the...adaptation to a particular climate, perhaps it would be a more prudent arrangement to...decree that the Surveyor General's office should be fixed in such part of India as would most conduce to maintain him and his subordinates in sound health...of body and mind.
>
> I can see no object gained by keeping the Surveyor General at the Presidency, unless he were admitted to the Council Board, and allowed to deliver his statements and opinions viva voce, which certainly might save a vast deal of trouble and...correspondence. ... The Surveyor General ought...to be as near as circumstances will allow to...the most important portion of the operations. ... The operations of the Trigonometrical Survey of India form not only the most important, but the only important portion...in-as-far-as permanency is concerned. ...
>
> I quite concur in the opinion of the Honourable Court of Directors as to...uniting the offices of the Surveyor General and the Superintendent of the Great Trigionometrical Survey in one person, but then the person selected should be intimately acquainted, both practically and theoretically, with the working of all parts of the machinery[3].

Everest had long given notice that he wished to retire when all work connected with the Great Arc had been brought to a successful close [317]. The remeasurement of the Bīdar base-line in December 1841 was the final task in the field, and there then remained about two years' work on the computations, adjustments, and reports. After Jervis retired, Everest began to push the claims of Andrew Waugh to succeed him. In June 1842 Waugh applied formally that his name should be put before the Directors, but this the Supreme Government would not undertake, though the Governor General's private secretary told Everest that,

> if it lies with the Indian Government, ... Waugh's claims will meet with a fair and full consideration from the Governor General. ... You are the best judge of the fit man to carry on your operations, and of course it was with pleasure that I read your strong recommendation, ... as I really think him the ablest person for your successor[4].

Everest pleaded strongly that the two offices should continue to be combined in one person, and that the Surveyor General should make his headquarters within close reach of his trigonometrical parties rather than at the Presidency;

> The Court of Directors have expressed their determination that the offices...shall be held by one and the same individual, and not only has this original resolution been in no wise shaken,

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[1] CD to B., Mil., 4-11-41 (8-9). [2] ib. 25-5-41, (17). [3] DDn. 402 (15-22), 11-9-40. [4] from Henry Durand, PS to GG., 24-6-42.

> but manifold confirmatory orders have...been issued, ... and so strongly worded as to leave no doubt whatever that my Hon'ble masters intend firmly to abide by their purpose. ...
>
> It is the wish of His Honour the President in Council that the Surveyor General should be at the Presidency, but as that would be...contrary to the repeated desire of the Hon'ble Court of Directors, and would involve the necessity of...returning to the exploded system of having a Superintendent of the Trigonometrical Survey in the field, in addition to the Surveyor General, ... I...recommend that...the subject should be referred to...the Hon'ble Court. ...
>
> Calcutta is of all places in India perhaps the most objectionable [318]. Its hot, damp, and unwholesome climate—I speak from my personal feelings—cramps and disables all vigour of mind and body. Its confined state, blocked up on all sides with walls and trees, permitting no elbow room, and offering no available spot of ground on which platforms may be put up, and instruments have a free range whereon to try them and their powers—the fascination of its society, too attractive to be resisted—... these and many other features...are quite condemnatory of Calcutta as a site for the Surveyor General and Superintendent of the G.T. Survey of India. ... The project appears...analagous to that of attempting to improve the powers of the falcon by clipping its wings, and confining it in a hencoop or dovecot[1].

In November 1842 Everest submitted his official application to resign, strongly recommending that Waugh should succeed, and pressing this with a personal letter to the Chairman of the Court of Directors ;

> I shall presume that it is the fixed intention of the Hon'ble Court to adhere to their often avowed determination to have no other system of survey...in their settled provinces of India than that pursued in the G.T. Survey of India at the present day. ... I cordially concur in the decision...of having no other system for the foundation of their Atlas [303, 309]. ...
>
> But a Trigonometrical Survey cannot be conducted by any person without...apprenticeship and training in the field, combined with a respectable portion of mathematical knowledge. ... It would be as consistent to expect a person to lead in a concert without learning the rudiments of music, as to look for efficiency in an untried practitioner in Trigonometrical operations. ...
>
> I have taken great pains...to train up an efficient establishment. ... It is not now, as it was in 1825, to search for a fitting person to fill my seat, and search in vain [III, 308]—I am no longer necessary to the work—there are several proud to call themselves my pupils, ... all quite as able...to carry on the work, ... Waugh, ... Renny, ... Jacob, ... Logan. ...
>
> The Great Arc of India has been brought to a conclusion, and the portion executed by myself and my subordinates...north of Bedar...is, I am proud to believe, as perfect a performance as mankind yet have seen. ... I have done my portion, and what time and circumstances would not allow me to execute myself I have deputed to younger and more active men, who are better able to endure fatigue. By far the larger portion...thus deputed has been effected by Lieutenant Waugh, my Astronomical Assistant. ... His talents, acquirements, and habits, as a mathematician, a scholar, a gentleman, and a soldier, are of a high order, and as such I feel that in recommending him as a fit person to succeed me, I do but perform the last essential service...to...masters from whom I have received so many acts of kindness[2] [357].

To the Deputy Chairman he added that

> there are but few officers in India who have ever had any experience in Trigonometrical operations, and...those who have only been accustomed to the ruder modes of surveying would have much to unlearn before they could begin to learn aught [353]. ... If your Hon'ble Court had the whole world at your disposal wherefrom to select a person whose sum total of practical skill and theoretical attainment, powers of endurance, and all other essential qualities were a maximum, Lieut. Waugh would be the very person of your choice[3].

In their letter of 3rd May 1843 the Directors recorded their appreciation of Everest's distinguished services, and sanctioned the appointment of Waugh to succeed "on a salary of rupees 1,500 per mensem, with the pay and allowances of his regimental rank" [III, 346 ; IV, 328–9]. Regarding headquarters they added that,

> in consequence of the completion of the Great Arc, ... Lieutenant Waugh will...be enabled to give early and effectual attention to any references which you may have occasion to make to him. ... We...hope that you will not...withdraw him from the duty of superintending in person the operations of the meridional surveys for...ensuring his presence at Calcutta. ...
>
> The Surveyor General's headquarters should, for the next year or two, be at Allahabad or Benares, as being central positions for the Trigonometrical surveys in progress. The Deputy Surveyor General will be stationed at Calcutta[4].

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[1] DDn. 402 (371–86), 15–8–42. [2] to M Gen. Sir J. M. L. Lushington, CB., Chmn. CD. EIC. ; DDn. 438 (122), 5–12–42. [3] DDn. 402 (399–406), 6–12–42. [4] CD to B., Mil., 26–9–43 (33–4).

On the break-up of the two parties that had been engaged on the Great Arc, and the transfer of their establishments to new work further east, the Superintendent of Trigonometrical Surveys would be free to pay visits of inspection. Everest had already been on a tour early in 1843, visiting Du Vernet, Waugh, and Logan [64, 71], He writes to the Collector of Morādābād ;

> I was in search of my trigonometrical parties, who are, as usual, never to be heard of... until one arrives in their immediate vicinity. I fell in with the first party, ... that under... George Logan Esq., near Bijnour, at an obscure place called Mahesri, and shall halt here until the rain subsides, which I conjecture will be till the 29th., on which day I propose making the first march in the following route...[to] Morādābād, 3rd February.
>
> From Morādābād I intend to go to Rampur, and thence to...inspect a party under...Captain Waugh, whom I expect to meet in the neighbourhood of Pilibhit [67]. ... After having inspected Captain Waugh's operations, I propose returning westward to inspect other parties in the neighbourhood of Anoopshahr and Bulandshahr[1].

He made plans for the journey to Calcutta where he proposed to hand over ;

> I...recommend that as soon after the end of the rainy season as travelling can be commenced with due regard to the safety of the records and the health of the establishment, the portion of my office in the field be allowed to proceed to the Presidency by water. I beg to specify the 15th September as the day of starting.
>
> I wish to take Captain Waugh with me to Calcutta, because he will then be at hand to receive charge at...my embarking for England[2].

As a necessary preliminary he applied to the Accountant-General for

> the prescribed certificate of there being no demands against me in your office, for the want of which I cannot send in my formal application to resign. ... As I have for years studiously avoided advances of money, and always expended my own funds on the public account when necessary, ... this certificate, ... as far as cash is concerned, can involve no difficulty whatever, I may have demands against the Government, the Government can have none against me. ...
>
> Public property standing at my debit...must be equally free from complication. I have given Captain Waugh...access to all my office documents, and...he is quite consentient to take the responsibility on himself, but he is naturally anxious that...my official records should be confirmed by...your office. ...
>
> My passage is taken, ... and it will subject me to serious inconvenience if my arrangements are put off to the last moment on account of the want of timely permission to resign[3].

The no-demand certificate was duly attached to his application "to resign...on the pension of a full Colonel"[4]. His resignation was gazetted under General Order of 1st December, and he sailed in the *Bentinck* steamer on 16th, on which date Waugh succeeded as Surveyor General and Superintendent of Trigonometrical Surveys.

Through Everest's energy and genius the shape and character of the Great Trigonometrical Survey had now been determined, and the pattern set for its steady extension and for the construction of worthy topographical surveys and maps.

DEPUTY SURVEYOR GENERAL, REVENUE SURVEYS, ALLAHĀBĀD

Revenue surveys had been started in the Upper Provinces in 1822 by Hodgson as Surveyor General, and then administered by him as Revenue Surveyor General from 1823, and again as Surveyor General from 1826. When he took furlough in January 1829, they were taken over by Herbert, first as acting Surveyor General, and then as Deputy S.G. and Superintendent of Revenue Surveys. On his transfer to become Astronomer to the King of Oudh at Lucknow, the charge was held by the Surveyor General till the question of successor was settled [314][5]. The appointment was eventually given to James Bedford, who had started survey in Rohilkhand in 1822.

Office was to be located at Allahābād, so as to be in close touch with the Sadr Board of Revenue, Western Provinces, and was to be completely independent of the Surveyor General. Everest was glad to be free of all responsibility for revenue surveys, though much disappointed at losing the assistance of a professional Deputy at his own headquarters. The Government order making this appointment issued on 11th June 1832, and Bedford took up duty about 10th September. Though he claimed the salary of Rs. 750 a month from 11th June, on the grounds that he had received orders on that date at Bareilly, it was ruled that he could not draw it until he reached Allahābād[1].

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[1] DDn. 453 (8–9), Mahesri, 28-1-43. [2] DDn. 452 (30–6), 10–7–43. [3] DDn. 453 (79), 16–8–43. [4] ib. (99) to AAG., 6–12–43. [5] SG. to Mil. Dept., 21–6–32 ; BMC. 3–9–32 (137).

The immediate business was a conference called by the Governor General, to which all officers interested in revenue surveys, both civil and professional, had been asked to contribute proposals, and to attend for discussion. Bedford being compelled to ask for two months leave, the conference had to be postponed till 20th January 1833 when Lord William Bentinck presided in person. Drastic changes were made in the system of survey, and the raising several new survey parties was ordered [7, 213–4].

Bedford asked for a special allowance for inspection tours,

> which, including a week's halt at each survey camp, will take...about 4 months. The bulk of my office would of course remain at Allahabad, and one writer...answer all common purposes during the deputation. ... The opening of the roads after the rains appears the most eligible time for commencing these visits, if considered necessary, and more particularly during the present year, as the new arrangements would then probably be in full operation, and a good opportunity be afforded of personally ascertaining the difficulties[2].

Tours of inspections were not in favour except for Revenue Commissioners and the like[3], and it was "not considered necessary at present that Captn. Bedford should travel to the districts in which the other surveyors will be employed", but as he appeared to have time on his hands it was proposed that he might supervise a small party near Allahābād, a suggestion he rejected as impossible ;

> The task of verifying the numerous returns...would fully employ the entire time of both the surveyor and a well-qualified office assistant, ... and...leave no leisure for other duties. Those of my own situation, also, are daily increasing with the area surveyed, and the khasrah measurements now entrusted to the Revenue Survey Department have...multiplied points of discussion and reference. Even if time admitted, however, which it does not, the two duties seem likely to lead to embarrassment[4].

He was then directed to raise a special detachment for this Allahābād survey, which an assistant, Henry Lawrence, should run under his supervision. Lawrence was, however, required elsewhere [214], and the Allahābād survey was postponed.

Bedford certainly had no lack of work in the administration of his numerous field parties, with many officers entirely new to the work, and organization to be adjusted to the wishes of the Revenue Board and the district officers. Though working for the Board, he was not directly under their orders, and in many matters corresponded directly with the Government of the Western, or North-Western, Provinces. Office accommodation was difficult to find ;

> The duties of my office could not be performed in an exposed building like Doorjun Saul's late prison during the high winds, dust, and rain, experienced about the end of January. ... These duties were expressly forbidden to be conducted in the quarters which General Marley [II, 40–1] had the kindness to offer for my personal accommodation.
>
> I had no resource, therefore, but to secure from 1st February, the most eligible of the few remaining places at the station, at a monthly rent far above my own present means[5].

As a professional surveyor with high regard for accuracy and precision, Bedford was not prepared to sacrifice these for the sake of the increased out-turn and speed required by the Board [215–8]. He was particularly disgusted to find in 1837 that members of the Board had been consulting his own junior officers, Lawrence in particular, before issuing orders for accelerated progress without reference to him, the Superintendent of the surveys. He concludes a letter to James Thomason, officiating Secretary to the Lieutenant-Governor, complaining of

> the undue influence which the civil branch of the survey is acquiring, and the evil will I fear

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[1] BMC. 23–4–33 ; BTC. 13–5–33. [2] from DSG., 26–4–33 ; BTC. 20–5–33 (43). [3] *JASB.* VIII, 1839 (598) [421]. [4] from DSG., 15–6–33 ; BTC. 2–9–33 (15). [5] BTC. 5–8–33 (34).

> daily increase, unless the Sudder Board—leaving to the Superintendent the internal management and details of his Department—confine themselves to that general control...which alone was, I conceive, the intention of Government to confide to them. ... I am quite unconscious of ever having neglected (even under many severe private trials) the duties of the office with which I have been honoured. It has proved no sinecure[1].

He had already on several occasions disagreed with the Board on the question of appointments and promotions of his professional staff, and had done his best to uphold his officers in disputes with the district revenue officials [230, 363];

> I have now been 16 years in the Revenue Survey Department, the last five years as its head, and if unacquainted with the character and fair pretensions of the officers under my control, should consider myself unworthy to hold the hitherto responsible office with which I have been honoured[2].

Protest to the local Government availed nothing, in fact Thomason had strongly supported Merttins Bird in bringing in the new policy and the Government of India upheld them. Both parties were undoubtedly pleased when a request came from Calcutta for the loan of Bedford's services;

> The number of Revenue Surveys...in the Lower Provinces...is very great, & the inconvenient absence of all high authority from the Surveyor General's office has deprived this quarter of all superintendence but that little which the Committee have been able to afford [297–302]. As...it is very desirable, not only on the score of economy, but of unity of action, that such extensive operations should be effectually superintended, the Governor would suggest...that...Captain Bedford...might advantageously be summoned to Calcutta for the ensuing cold weather at least, ... in order that he may place the surveys of these Provinces upon a proper uniform footing, and provide for the future supervision of the officers employed upon them.[3]

Bedford took a few weeks clearing up at Allahābād ;

> If allowed to remain until the middle, or...end of next month, the accounts of the season would...be made up—my annual report dispatched—the map work of the season put in progress—and the Law Commission map...finished with the general population statements of the Western Provinces [233, 286]. If...the duty be of a temporary nature, I could then proceed to Calcutta for a couple of months, and make the same arrangement with regard to my office at Allahabad as on the two former occasions when I went on short leave to the Presidency. ...
>
> If...my residence is protracted in Calcutta I should require the records for reference, and...recommend that at least the writing department, if not the whole, be allowed to accompany me. I should thus be able efficiently to superintend the general work wherever I might be, whereas if left for any long time at Allahabad, the office would be comparatively useless without me, while I should myself be greatly embarrassed[4].

The Board suggested that William Brown should be brought down to take charge during Bedford's absence, but Bedford would not hear of this for, though senior as a soldier, Brown was junior as surveyor to both Wroughton and Birnie Browne. When, therefore, Bedford left on 9th December, charge of the surveys was taken over by Henry Elliot, civil service, Secretary to the Revenue Board [289 n.3].

On Bedford's arrival in Calcutta early in January 1838, the Board of Revenue of the Lower Provinces was directed "to lay down such rules for his guidance as they may deem proper, conforming as far as may be to the practice of the Sudder Board of Revenue in the Western Provinces"[5]. For some months he was in the unsatisfactory position of not knowing how far he remained still responsible for his office staff at Allahābād, and of being without facilities or status at the Surveyor General's office at Calcutta. He was still resentful towards the Board of Allahābād, and appealed to the Supreme Government ;

> His Lordship having placed on record so decided an expression of his sentiments, I cannot ...press my general appeal against the conduct of the Western Board in the case of Captain Lawrence [217]. What has already been urged will, I trust, sufficiently exonerate me from the responsibility hitherto imposed respecting the general revenue survey expenses in the North Western Provinces, and the instruments of the Department (placed at my personal debit), over both of which I have now no efficient control. ...

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[1] DDn. 301 (264–13). 12–10–37.

[2] from DSG., 31–10–37 ; NWP. Rev Bd., 3–11–37 (77–8).

[3] from Govt. of Bengal, 7–10–37 ; BRC. 12–8–38 (82).

[4] from DSG., 10–11–37 ; BRC. 12–8–38 (126).

[5] BRC. 30–1–38 (43).

I submit for His Lordship's consideration ; ... I am obliged to keep up a separate establishment at Allahabad to look after my property, not to mention that with a buggy and horse useless at that station, I am...hiring conveyance at Calcutta. ... I am further compelled, not only to pay house rent in Calcutta, but...to find accommodation for such office as the Lieutenant Governor has been pleased temporarily to authorise.

The loss to which I am thus subjected actually reduced the value of my combined staff salary to about 500 per mensem, or less than that enjoyed by a surveyor. ... As three months are now elapsed since I quitted Allahabad, and the period of my absence is still undefined, I...hope that...some temporary allowance will at least obviate a positive loss[1].

The Governor General saw no reason for complaint[2]. After several months, however, it was arranged that Bedford should sever all connection with Allahābād, and take over charge of the Surveyor General's offices at Calcutta in addition to the surveys of the Lower Provinces. These changes came into force in October 1838, with the consent of the Government of the North-Western Provinces ;

It...appears that Capt. Bedford has ample employment in the superintendence of the Revenue Surveys in Bengal, and that he feels himself hampered by the duties and responsibility still attaching to his post at Allahabad. The arrangement under which the great bulk of his duties were transferred to the Secretary to the Sudder Board of Revenue has answered the purpose for which it was adopted on...Captain Bedford's sudden removal. ...

At the same time...the importance of...the survey and settlement of these provinces requires great attention and high scientific attainments. It is also important that these qualifications should be kept in complete subordination to the Sudder Board of Revenue, with whom the direction and superintendence of the whole must rest. ...

His Lordship proposes to attach to the Sudder Board...a scientific officer as a secretary, who shall be the channel of correspondence[3].

The outbreak of war with Afghānistan prevented the posting of any professional survey officer, and Elliot continued to administer the Western surveys until they were closed down at the end of 1842 [217, 229, 289–3].

Bedford continued to hold charge of the Surveyor General's offices in Calcutta, and of the surveys under the Revenue Board of the Lower Provinces, until he resigned on 1st January 1843, having served continuously in India without once leaving the country since his first arrival on 25th September 1809. No successor was appointed until Wroughton's return from furlough in March 1844.

At no time after Bedford had taken over had Everest ever exercised any control over the revenue surveys, although the Directors had expressed their wish in 1840 "that the general direction of all revenue surveys should be confided to the Surveyor General...only so far as will ensure the application of scientific principles on one uniform system to the several surveys"[4] [315].

DEPUTY SURVEYOR GENERAL, CALCUTTA, 1838–42

When Everest returned in 1830 he found James Herbert holding office under Walpole as Deputy Surveyor General and Superintendent of Revenue Surveys [III, 306]. Herbert had long been closely associated with Hodgson, not only as surveyor in the field [III, 33–5], but from December 1821 to 1823, and again from 1828, as Assistant Surveyor General at Calcutta [III, 309–10]. On Hodgson's departure, he held charge of the department till Walpole took over at the end of October 1829, and then continued as Deputy Surveyor General in charge of Revenue Surveys. Everest had a great respect for his abilities, and reported in June 1831 that Herbert had been

for some time seriously indisposed, and...will be obliged to go to the Cape of Good Hope or New South Wales for the recovery of his health. The loss...will be very great to me, because he is not only a gentleman of much talent, but one on whose judgement I can at all times confide. As a Deputy he is to me invaluable, because he lightens by one half of the load of business with which my office is encumbered.

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[1] from Bedford, 1–3–38. [2] reply dated 16–3–38; BRC. 6–11–38 (7). [3] from NWP., 3–9–38 ; BRC. 13–11–38 (46). [4] CD to B., Mil., 10–6–40 (6) ; & 25–8–41 (19) ; BRC. 20–10–40 (3).

Allow me, therefore, to hope that the officer nominated to act as Deputy Surveyor General in his absence may...be capable of affording me the same important and efficient aid. ... This is necessary at all times, but will be particularly so in the last months of this year when the base of verification is to be measured [48–9][1].

[Again on 29th September]. Captain Herbert...was about to vacate his situation in order to proceed to England. His health having since been reinstated, he has given up...his design, but is nevertheless still likely to quit the Department. ... I have since had...the acquaintance of Lieutenant Wilcox, and...he is the very person whom I should seek as a really efficient assistant. ... I hope that...Lieutenant Wilcox may be nominated as a successor to Captain Herbert[2].

Herbert resigned from 9th December 1831 on appointment to charge of the Lucknow observatory [115]. Not only, therefore, was Everest now left without any assistant or deputy in his heavy office duties, but from December 1831 to June 1832 he was burdened with control of the revenue surveys just when he had great pressure of important geodetic work [3, 12–4]. In spite of his request for Wilcox, Government insisted that the appointment should go to Bedford, the senior revenue surveyor, who was to be stationed at Allahābād [314]. Wilcox who was nearly ten years the junior[3], with a very short experience of revenue surveys [III, 333], was obviously less suitable for so important an independent charge.

It was indeed very poor policy to leave so important an officer as the Surveyor General—whose responsibilities for maps and surveys extended to the furthest limits of India—without any personal deputy or assistant whilst he was engaged, not only in supervising, but actually performing, the highly technical and specialized operations of the trigonometrical survey. No provision whatever was made for the conduct of normal routine business in the case of his temporary sickness or absence.

Though he repeatedly appealed for assistance, and represented the strain of all this work on his efficiency and health, no assistance was provided until 1838. The parsimony that governed this policy extended even to Bedford's appointment at Allahābād, which the Directors approved only so long as

the Surveyor General himself shall be occupied in measuring an arc of the meridian or other field duties, but...on his return to Calcutta, the appointment of Deputy Surveyor General at your Presidency shall cease[4].

Whilst control of the field office at Dehra Dūn rested with the Registrar, Charles Morrison, Everest left his Calcutta offices under charge of Joshua De Penning ;

When letters arrive from the Military Secretary's office[5] containing queries to be answered for the information of the Court of Directors, you will...consult with Mr. Graham [295], and forward them to me, specifying where I can put my hand upon any particular document. ... Any information that either he or you can furnish...I shall be grateful for. ...

When...maps are ready for dispatch to England, ... you should report...that you have duly examined and compared them, ... [to] enable me to decide whether they require to be inspected by me. ...

In regard to...the computing office, when any number of the skeleton forms have been filled up and duly examined and compared by you, ... send one set under cover to me with any remarks you may have to make addressed to your deputy Mr. John Peyton [325–6, 379–80]. In the ordinary course of business a packet once a month will suffice. ...

Public letters requiring an immediate answer, and all private letters to my address must be sent...to await me. ... I empower you to open all letters directed to me on service, to give specific replies if you can, and where you have any doubt to send the correspondence to me[6].

On Bedford's transfer to Calcutta at the end of 1837 he was given no official responsibility to the Surveyor General, though such possibility had been hinted at. Everest writes to De Penning ;

Captain Bedford has been sent to the Presidency to settle the revenue survey affairs. I have received an intimation from him on the subject, but none from Government, and therefore do not conclude...that he is to interfere with my office. ... But things are managed in an odd way under this Government. ...

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[1] DDn. 265 (200–2), 2–6–31. [2] ib. (251), 29–9–31. [3] and 14 years younger. [4] *Meridional Arc* (184) ; CD to B., 16–1–38 (6) ; DDn. 282 (246–51). [5] Sec. to Govt. in the Mil. Dept. [6] SG. to De Penning, 19–12–32 ; DDn. 266 (249–52).

> I wish you to wait on him, and show him all manner of deference and respect from you and all my department. If he can assist you in franking letters to my address, I had rather it should be done by him than a stranger. Make my compliments to him and say so[1] [344].

After Everest's interview with the Governor General in March 1838 [317], Lord Auckland asked the Bengal Government whether Bedford could take over charge of the Surveyor General's offices at Calcutta in addition to the revenue survey parties, and Bedford agreed that he could do so if he were relieved of all responsibilities at Allahābād. This change was brought into effect in October when he was officially appointed to "take charge of the office of the Surveyor General at the Presidency. ... This charge is not to interfere with the supervision... over the Revenue Survey in the Lower Province".

On the 10th October, therefore, Bedford assumed charge of the correspondence and drawing offices, and the instrument workshop, leaving De Penning in independent charge of the computing office, and as such entitled to correspond direct with Everest as Superintendent G.T.S.; "the computing establishment has from its origin been quite distinct from that of the Surveyor General". From 1st December 1839, after protesting his "utter inability" to retain charge of the workshop, Bedford was authorized to hand it over to Boileau [129][2];

> When applied to on the subject, ... I distinctly stated that I could not undertake the charge... if it included anything beyond the superintendence of the map and plan work, with the current correspondence. The various points of reference...from you—from so many surveys...—and... from the Sudder Board—engross so much of my time that, even though commencing on the rough draft of my letters about 8 in the morning, I can scarcely keep the work...from falling into arrears. ...
>
> As a mere channel of communication between the public departments and the officiating Mathematical Instrument Maker[3], I make no objection, but I...protest against being embarrassed by the details, ... to which it is impossible for me to attend without neglecting the duties of the Revenue Survey Department[4].

It is hardly surprising to find that difficulties occasionally arose between Bedford at Calcutta and Bontein at Dehra [327], and an unhappy correspondence took place in which Bedford expressed deep resentment at blame being passed to him by so junior an officer. He refused to accept Everest's explanation, and asked that the whole dispute, and the lack of satisfactory redress by the Surveyor General, should be laid before Government, which Everest refused to do;

> I am prohibited to send documents of the sort...to the Military Secretary's office [374], having been specifically made acquainted that His Lordship had neither the time nor inclination for the perusal of voluminous correspondence of the subject of the petty squabbles of members of my establishment. ...
>
> I am not about to prefer a complaint against you, but...you are the person proposing to do so against me; ... any representation laid before His Lordship must be addressed by you to...Government, detailing the grievances complained of, and be forwarded...through me[5].

Bedford very wisely dropped the matter, but a few months later there was further trouble. He had given certain advice to Government without obtaining Everest's prior approval, and Everest was indignant when he heard of it. His letter of protest —expressing complete distrust of his Deputy—met with stern rebuke, and it was a long time before the trouble blew over.

In spite of this distrust, however, Everest was constrained by his pre-occupation with the Great Arc to pass over control of the Madras and Hyderābād surveys, an extra responsibility that Bedford accepted cheerfully [248, 317][6]. By 1842, doubtless because Everest was now clear of anxiety for his professional work and the Jervis controversy, relations had recovered a friendly tone, and he was happy to place De Penning and the sacred computing office under Bedford's control;

> The highly satisfactory manner in which you have conducted the duties of my office... induces me to beg...you to take charge of the computing office also, and...I empower you to communicate to Mr. De Penning that it is my desire that he place himself and the computers...under your orders—that he will receive all his instructions from me through you—

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[1] DDn. 346 (454-7), 29-12-37 & 304 (158), 4-1-38. [2] DDn. 297 (159-60), 16-8-39. [3] Ernest Gray [128]. [4] DDn. 297 (127-9), 6-11-38. [5] DDn. 354 (54-6), 25-8-39. [6] DDn. 355 (215-6), 5-5-40.

> and send any communications which he may have to make, either addressed to me, Captain Bontein, or the Deputy Computer, Mr. Peyton—through you—open for your inspection[1].

Bedford accepted this charge so long as it did not involve him in "the details of the computing office work", which would still rest with De Penning.

This arrangement was of short duration, however, for Bedford retired from 1st January 1843, and as the Directors had stated that they would not approve the appointment of another officer as Deputy Surveyor General [324], he handed the drawing and computing offices over to De Penning and the duties of Superintendent of Revenue Surveys to the Sadr Board of Revenue[2].

It was indeed hard that Everest should have been deprived of both his deputy and personal assistants for his last year [259].

ASSISTANT SURVEYOR GENERAL, 1838–42

The post of Assistant Surveyor General at headquarters had been held by James Herbert from 1827 to January 1829 [III, 310 ; IV, 323]. In March 1838 Everest obtained the Governor General's promise of assistance at his headquarters, but finding that action was only being taken to provide a Deputy at Calcutta he insisted that his more urgent need was for an officer to take charge of his field office at Dehra Dūn ;

> 1st. To examine plans, maps, fieldbooks, and other documents of the various surveys sent...from the three Presidencies, and to attend to the correspondence relating to those surveys.
>
> 2nd. To assist generally in...arranging from...these materials such maps...and charts as may be required...by the Hon'ble Court of Directors.
>
> 3rd. To attend to the correspondence and comply with the requisitions of...the three Presidencies. ...
>
> 4th. To examine all the accounts...and to exercise a general supervision over the office of the Surveyor General while he is in the field, or when engaged in...computations. ...
>
> 5th. To aid the Surveyor General in carrying on the public correspondence. ...
>
> 6th. There is a large assortment of instruments...scattered in diverse portions of the country ; ... to retain and arrange the receipts...and the authority under which they have been respectively issued...will be an essential item of the Deputy's duty.
>
> 7th. To...report any deficiency...or injury...to the said instruments. ...
>
> 8th. To superintend the annual statement of the instruments required by the Accountant General[3]. ...
>
> The first step...is the appointment of an efficient Deputy, for without that my Department is entirely paralysed. Even a Captain in temporary command of 4 companies of Native Infantry has an adjutant, ... yet I, who have duties surpassing these as much as the sands of the sea do the area of a citizen's grass plot, have no responsible officer to render me the least help in the...extensive business of my office.
>
> This is really a crying evil. ... True it is, ... that the difficulty of meeting an officer at once willing and able to cope with the onerous duties...is one of the principal obstacles, ... but, ... by how much these duties are more than ordinarily ardous, by so much the more indispensible does it become that I should have some competent person to share them with me. ...
>
> It is, in fact, because all my three Deputies have been removed that no officer is at hand who has the slightest training in the office duties. ... If my warning voice had not, like that of Cassandra, been raised in vain, nothing of this sort could have happened [14, 327–8][4].

He was authorized to find an officer of his own selection for his field office, and after serving on trial for several weeks John Bontein was appointed "Assistant in the Office of the Surveyor General"[5]. Everest writes ;

> It is a great object to me that the gentleman appointed as my assistant should stand in need of as little instruction as may be, ... and where that is requisite he should be tractable and ready to learn. Of the two I should esteem the latter as the more important requisite. ... I took the liberty in March last to mention the name of Lieutenant Durand, of the Engineers [351]. ... I conclude...that there is some objection to this measure.
>
> I...mention...Lieutenant Bontein, of the 51st N.I., as a gentleman for whom I have a personal regard. ... He has been 12 years on actual duty in India, and...has never been away

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[1] SG. to DSG., DDn. 406 (239), 18–4–42 ; DSG., to De Penning, ib. 413 (12). [2] BMC. 2–12–42 (17), B to CD., 5–7–43 (6). [3] DDn. 348 (165), 28–3–38. [4] DDn. 342 (202–13), 11–6–38. [5] Staff Salary Rs. 200 p.m. ; GO GG. in C., 9–10–38.

> from his regiment. ... He has both aptitude and inclination enough to render him a highly efficient assistant within a shorter period than I could expect from a stranger[1].

Bontein accompanied the Surveyor General to Kaliāna during field season 1838-9, and proved most useful. In June 1840 he withdrew an application for sick leave when he found it entailed the loss of lien on his post, though Everest would have preferred a capable substitute ;

> Though decidedly in opposition to the advice of his medical attendant, Lieut. Bontein has preferred attending office at any risk to...being deprived of his appointment. ... In truth, I require an efficient assistant now more than at any other period for—not to mention the utter impossibility of attending to the details of office business whilst...sitting up by night to observe stars, and examining laborious...computations—the arrangements preparatory to the termination of my career...ought to...leave the affairs...in an...unconfused state. ...
>
> If I have an assistant either inefficient, or only half efficient from ill-health, ... much will remain undone and much ill done[2].

In October 1842 Bontein was recalled to his unit for military service, though Everest urged that he had "relieved me from the intense load of onerous routine, ... which in his absence must either be neglected or must go to fritter away my whole time". On his return in March Government decided that his services could no longer be spared, and in spite of earnest protests[3], Everest was left with no office assistant.

DEPUTY SURVEYORS GENERAL, MADRAS & BOMBAY

For better control of the department, Everest suggested in 1832 that the map depots at Madras and Bombay should be transferred to Calcutta, together with the Deputies in charge, a measure which

> would...be economical both as to time and money. ... Officers engaged in survey under the Bombay Presidency report to the Deputy Surveyor General there, and partial accounts of their operations come to my office by a circuitous route. It is in vain that letters have been written to Captain Jopp, urging him to be more regular. ... I literally know nothing of what is going on, except as to the Trigonometrical Survey carried on by Lieut. Shortreed, who was placed in April last in direct communication with me, and from whom...I receive my information well nigh as punctually as from any officer...in the Bengal Presidency [72-3].
>
> The survey of the Nizam's Dominions is also carried on under my...control [248]. ...
>
> It would not be advisable to dispense in the first instance with the appointment of an officer as Deputy from each of the other Presidencies. ... The duties would be susceptible of more equal distribution[4].

After further correspondence he repeated that he saw no reason

> why the work...could not be conducted quite as satisfactorily at Calcutta as at Madras. ... I fully appreciate the able services of Captain Montgomerie, but it is not proposed to dispense with those services. We on the Bengal side...may, on the contrary, look to derive much benefit from a nearer acquaintance with the topographical system in force at Madras, and a person of Captain Montgomerie's practical acquirements could not but be of essential service in establishing that uniformity which is so desirable. ...
>
> [Is] it proper to maintain an office at Madras for the guardianship of topographical documents ? If the whole of India were completely surveyed, would it be worth the expence to keep an office of the kind at each Presidency ? Assuredly one such depot would be sufficient. ... It is not shown why maps...for immediate military use cannot be lodged with the Quarter-Master General ; why the civil authorities at Fort St. George cannot be supplied from Bengal, ... and...why the depot for the whole of India should not be at Calcutta. ...
>
> The grounds on which I recommended the removal of the Madras and Bombay branches... to Calcutta are that economy and efficiency would best be studied by having one establishment...in a steady uniform system, instead of three distinct establishments.
>
> That the duties which the Deputy Surveyor General has to discharge at Madras do not occupy his whole time is further proved by the fact that Captain Montgomerie has occasionally acted in other situations ; that he once acted as Astronomer, ... and at this moment fills the situation of Superintendent of Public Roads[5].

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[1] DDn 342 (213-5), July 1838. [2] DDn. 402 (52-3), 23-6-40. [3] DDn. 452 (24-5), 1-5-43.
[4] DDn. 283 (8-11), 12-1-32. [5] ib (166-9), 3-10-32.

Everest was unfortunate. Instead of his gaining two Deputies at Calcutta, the Directors ordered that the offices of Deputy Surveyor General

> at Madras and Bombay be discontinued at the earliest practical period, and that all maps and other documents which may be thought by the Surveyor General to be worth preserving in his office be sent to Calcutta ; the remainder being deposited in the office of the Chief Engineers[1].

This change took effect from 1st September 1833, from which date the Madras field parties were transferred to the direct control of the Surveyor General. Office personnel was distributed, some to Calcutta, and the remainder to field parties or other departments[2]. Committees were held to decide which records would be transferred to Bengal [297]. Both Montgomerie and Jopp declined transfer to the Great Trigonometrical Survey[3].

In 1841 the Directors refused a suggestion that the two offices should be re-established[4].

ACCOUNTS

The civil salary of the Surveyor General had been fixed at Rs. 1,500 a month in 1815 [II, 325]. That of the Superintendent Great Trigonometrical Survey was 400 *pagodas*, or 1,400 Madras rupees, Everest drawing the equivalent, 1300 *sicca* rupees, after Lambton's death. On his return in 1830 his salary was, much to his disgust, limited to Rs. 1,500 but, on his claim to an increase for holding the combined post, the Directors, "having compared the allowance...with those granted to other functionaries holding high military appointments", raised it to Rs. 1,800. They did not, however, grant his request to rank as Lieut. Colonel[5]. In addition to this staff salary he drew—as artillery captain—pay Rs. 140 ; *batta*, Rs. 182-10 ; gratuity Rs. 36 ; house rent Rs. 90 ; altogether Rs. 2,248.

> Your office in the field will, of course, be considered a public charge, but it is hoped the expenditure...will not amount to so large a sum as three hundred...rupees per mensem. ... Your instruments or other bonafide office property will be carried at the public expense[6].

On leaving Calcutta he was allowed tentage and boat-allowance "or a sum equivalent thereto" in exchange for house rent of rank[7], and was extremely surprised to receive an official letter more than two years later noting that he was

> in receipt of an allowance for boats to the extent of Rs. 360 per mensem, in addition to the full batta and tentage of your regimental rank [329].
>
> Boat allowance appears to His Lordship in Council inappropriate to an officer whose duties are entirely confined to land operations, and have for the last two or three years been performed in the Upper Provinces, and...the Himalaya Mountains. Nor does the ample and recently augmented staff salary which you draw in your double capacity of Superintendent Trigonometrical Survey and Surveyor General of India appear to require any such indirect addition. ...
>
> His Lordship in Council has deemed it necessary to resolve that boat allowance should not be passed to you after the present month[8].

He was not the sort to take this without a fight ;

> My drawing Tent Allowance and full Batta can by no means imply that I am to maintain a marching establishment, for I drew those allowances in England, and all officers who return to England, acknowledged as on duty, draw the same. Besides, my predecessors in the office of Surveyor General...drew those allowances, and never left Calcutta on duty.
>
> The addition of 300 sonat rupees to my staff salary as Surveyor General was conceded... before the question of my proceeding to the Upper Provinces was agitated. ... This addition... would have been equally conceded if I had never stirred from the Presidency. ...
>
> His Lordship...did not say Allowance for Boats, but "the boat allowance of my rank, or a sum equal to it", as a compensation for travelling expenses.
>
> I have been put to much extra expence, for all my servants required higher rates of pay to induce them to leave Calcutta. Moreover, I have been obliged to maintain a large marching establishment, for since the 1st of January 1933, when I left Calcutta, ... a period of 28 months,

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[1] CD to B., 16-1-33 (5). [2] In Bombay all fd. units were closed ; BMC. 26-7-33 ; DDn. 282 (274-6). [3] BMC., 30-5-33 (342) : DDn. 282 (252-6), 4¼ ; cf., BO GO., 3-7-33. [4] CD to B., Mil., 25-6-41 (20). [5] ib. 5-9-32 (17), DDn. 90 (103). [6] BMC. 19-11-32 (102) ; DDn. 282 (191-3), 24-11-32. [7] BMC. 9-11-32 (102). [8] DDn. 285 (192-3), 13-3-35.

> I have been actually under canvass 18 months. During that period I have marched over a distance of full 2,000 miles, carried on an approximate series along the Great Arc of 460 miles in direct distance, and measured a base of verification of 7½ miles in length. ...
>
> Doubtless...an allowance for Boats to an officer engaged as I am is inappropriate, and I should be sorry to have the task of drawing boats over the tracts where I have travelled for the last 2 years and 4 months, but a monthly sum equal to the Boat Allowance of my rank, to cover travelling expences, is not...inappropriate, and when it is withdrawn, as I shall have no other funds to meet the cost of locomotion, my utility in the Upper Provinces will be so circumscribed as to render my presence there of little avail.
>
> As a fixture in any place I shall be of much less use than at the Presidency, and I, therefore, beg, ... either that...my just expectations may be sanctioned, or that I may be permitted forthwith to return to the Presidency, ... bringing with me all my subordinates...who accompanied me to the Upper Provinces in 1833[1].

No doubt the truculence of his final paragraph may be explained by the state of his health [315], but it brought a sharp rebuke. His belated apology was not the only one he had to make after unseemly mockery in an official letter [157]; even as an apology it hardly rings of genuine penitence ;

> If in the course of advocating my pretensions I have given offence, I beg to...disclaim all intention of doing so. The style which persons of my professional pursuits acquire is peculiar, and may perhaps be tinctured with laconism and earnestness, which would well...be modified by a more liberal admixture of the phrases of common parlance. To this cause the Government will, I hope, kindly attribute any defect in my tone, manner, and remarks ; and believe that no person is more sensibly alive than myself to the necessity of subordination or would more resolutely discountenance any want of diffidence to superiors in authority[2].

The question of the allowance was referred home to the Directors, as the retrenchment had been personally ordered by Lord William Bentinck, and the Directors accepted the claim that the Surveyor General was "entitled to Boat Allowance of his regimental rank (or of a sum equivalent thereto) during his absence from the Presidency"[3]. This authority prevailed as late as 1930, in that the Surveyor General was still allowed to draw Rs. 300 a month throughout his absence from Calcutta.

Everest was promoted Major from 25th July 1832 and Lt.-Colonel from 7th March 1838. His paybill for July 1841 reads—Pay Rs. 343-8-0—*batta* Rs. 608-12-0—Tentage Rs. 150—Staff Allowance Rs. 1,800—Equivalent for Boat Allowance Rs. 450—Total Rs. 3,252-4-0. In the field he also drew Office Rent *sicca* Rs. 200, or Company's rupees 209[4] [331-2].

His assistant Bontein drew the humble pay of Lieutenant—Pay Rs. 60-14-0—*batta* Rs. 121-12-0—Gratuity Rs. 24—Tentage Rs. 50—Staff Allowance Rs. 200—Total Rs. 456-10-0. Bontein had to support a wife and children, Everest was a bachelor.

An account has been given elsewhere [III, 215] of Hodgson's trouble in getting a clearance certificate from the Accountant-General before his departure on sick leave in 1829, and Herbert gives the following account of how he settled it. Hodgson was called on to account for every issue of instruments for the last ten years,

> comprising the...proceedings of his two predecessors. ... In consequence of...the peculiar hardship of his case, and...the state of his health, ... Government...accepted my offer to account for all those instruments issued by him [and] to produce vouchers...possible to trace. ...
>
> The difficulties attending...accounts extending so far back...in the proceedings of three ...Surveyors General (two of whom were dead, and the other had left the country) might... account for the long delay. ... There were others springing from the sudden illness and subsequent death of the then Register[5], ... who...had not only kept the accounts of receipts and issues, such as they were, but also had the direct charge of the instruments. ...
>
> They have been, however, put at length into an intelligible form, and vouchers produced. ... I had supposed that on producing vouchers...the party to whom the instruments were issued would be held accountable, and the instruments written off. ... The Military Accountant, however, finds a practical objection...in...opening an account with each individual. ...

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[1] DDn. 286 (195-7), 2-4-35. [2] ib. (409), 3-12-36. [3] CD to B., Mil., 20-7-36 (9); DDn. 90 (115-6). [4] 15 Company's Rupees (introduced 1835) = 16 *sicca* (withdrawn 1838) [354]. [5] L. R. Burke, Registrar [II, 352 ; III, 215 n.2].

From the long period elapsed, and the death or departure...of those who made the issues, and of many of those who received the instruments, it would be...impossible...to trace all the articles. ... The Military Accountant...acknowledges...this, ... but...contends that...relief...must be sought in the just consideration of Government. ...

I...submit the accompanying statement of items which I humbly request...Government to write off, and pass to Lieut. Colonel Hodgson's credit. ... Some of them are clearly accounted for... —either loss altogether, as by sinking of boats on service—or instruments being retained by others into whose hands they had fallen on the death of the parties... —or...instruments being fairly worn out.

A few are articles of expenditure, such as Drawing Paper, Indian Ink, Pencils, Colours, etc., which...disappear, but which yet the officers of account require to write off. One is a set of Nautical Almanacs, a work that may be considered valueless after the expiration of the year to which it belongs.

Some are for repairs of instruments, ... which cannot evidently be added to the original prime cost. ... Others are for...interest, freight, etc., items for which the Surveyor General can scarcely be held responsible. Some are for packing cases and packing materials, which have been again used in dispatching instruments.

By far the principal amounts, however, are fixtures set up in...the present house for the convenience of the observatory. ... In reality these items do not occasion any difficulty to me, because such as Lieut. Colonel Hodgson received he delivered over to me, and I to Major Walpole. ... Being fixtures, ... there is no possibility of their being removed or embezzled[1].

It was ruled that—both for the past and future—the Surveyor General's responsibility for instruments would, on a satisfactory receipt voucher, pass to the individual to whom issue was made.

As in the past [III, 354–5 ; IV, 39], survey officers working in country far from headquarters and treasuries suffered long delays in drawing cash. Everest describes the difficulties experienced by Western

from a recent arrangement...of the Military Auditor General, whereby the contingent bills of the field parties...are to receive my countersignature before they can be audited [III, 346, 348]. ... Lieut. Western had advanced nearly 1,000 rupees of his own money...to meet the contingent expenses which must all be paid for in ready cash.

The paybills of the party for February were not paid by the Pay Master at the Presidency... [by] 5th May. The native establishment were grumbling and discontented...not receiving their pay regularly, and finally Lieut. Western, having no more money to advance, the operations of the party were suspended for want of funds. ...

It cannot be for the interest of the Hon'ble East India Company to reduce to inactivity so expensive an establishment...for...an ordinary contingent bill ; neither is there...any saving adequate to the cost of my costly time...in consequence of my studying such documents previously to annexing my signature. ... The arrangement is altogether novel, and has been made without my being consulted[2].

Government would not waive the Surveyor General's signature, but allowed surveyors to draw adequate advances to cover all expected contingent expenditure.

Amongst Everest's instructions is a note to Jones ;

Be chary of the expenditure of the public money, but when an expense must be incurred sooner or later, do not allow any ill-timed motives of economy to impede you, for that plan only appears plausible to short-sighted persons, and as it often frustrates the object in view... is much more costly in the end[3].

To Government, he notes that it is their anxious wish

to furnish me with every assistance, ... consistent with a due regard to economy, ... in order that the important operations...may be brought to an early and satisfactory conclusion. ... As economy has always been my study where it harmonized with efficiency, so I have generally rather stinted my Department even in essential points than otherwise, and have never made any new call on the liberality of Government until experience had convinced me of its necessity[4].

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[1] DDn. 265 (111–5), 5–1–31. [2] DDn. 286 (e–f), 22–5–33. [3] ib. (148–46), 19–1–38. [4] DDn. 402 (57–81), 24–7–40.

CHAPTER XX

OFFICE & FIELD ESTABLISHMENTS

SURVEYOR GENERAL'S OFFICE ; *Calcutta Premises — Clerks — Draughtsmen Computers — Correspondence* — BENGAL REVENUE SURVEYS ; — *D.S.G.'s Office — Field Establishments* ; *Western Provinces — Lower Provinces — Recess Quarters* — NOMINAL ROLLS ; *Clerks — Draughtsmen.*

IN November 1823 the Surveyor General, then Valentine Blacker, had taken No. 37 Park Street[1] for office and residence, and built an observatory on the roof [III, 187–8]. The rent was Rs. 450 a month. In 1828 the lease was extended by verbal agreement for another three years. From 1826 to December 1830, No. 36 was leased at Rs. 150 p.m. for the Revenue Survey office.

In October 1830 Everest obtained sanction to renew the lease of No. 37 for another five years, the rent being reduced to *sicca* rupees 420, as house-rents had fallen by about 20% since 1823.

> There is scarcely a house at Chowringhee so well adapted for the purpose of an office, where plans are to be drawn and instruments deposited, because not only the light is exceedingly well thrown in but it is dry and commodious. The situation is good. ... The small observatory on the upper terrace cost the Government originally...4,262 rupees, part of which being masonry must be left on the premises [III, 188][2].

A year later Everest asked permission to hire another house for his computing office, and reported that

> the office...is already very much crowded ; ... computations cannot be carried on effectually unless the computers be free from all extraneous disturbance. ...
>
> No. 37 Park Street...in 1823...was not then deemed too large for the establishment and personal accommodation of the Surveyor General alone. ... At the demise of Lieut. Colonel Blacker the Revenue Survey Department was united with that of the Surveyor General under Lieut. Colonel Hodgson and, the house No. 37 [being] too small for the two establishments, ... permission...[was] granted to hire the adjoining house No. 36.
>
> Since my arrival in October last, ... No. 36 has been given up and a vast supply of costly instruments...received, ... so that...No. 37 is now much more crowded than was contemplated. ... In fact, most of the more valuable and delicate instruments have been...lodged in the upper floors, ... so that nearly one half of the personal accommodation of my predecessors has been...applied by me to public purposes, and I can see no possible mode of making arrangements...without admitting the computers into my library, bedroom, and dining room, ... which...would subject me to the greatest inconvenience and annoyance[3].

Being authorized to hire accommodation for the computing office @ Rs. 200 a month, he first proposed to take a house at Ishrah, on the other side of the Hooghly, well away from "the noisy and crowded streets of Chowringhee" where it was impossible to test the larger instruments which

> are by far too cumbersome to be taken to the roof of the house, and there is no other place, where the telescope has any range, in which I can do my work without liability to intrusion. ...
>
> I have never been able to observe an angle with the beautiful large theodolite [141], ... for it cannot be put up without a tent previously pitched for it on some open space. ... I never had an opportunity of exercising my people with the measuring bars at all, until His Honour in Council was pleased to allow house-rent to the sub-assistants [370], ... on which...I availed myself of the small spot of ground attached to their house to give them a partial training. ... It is out of the question to look for a sufficient range for large telescopes in any private grounds in the immediate vicinity of Calcutta or Chowringhee[4].

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[1] Proprietor, James Bruce, builder ; Agents, Alexander & Co. [2] DDn. 265 (64–5), 12–10–30. [3] ib. (241–3), 9–9–31. [4] ib. (311–4), 15–11–31.

For various reasons this plan was not pursued, and the computing office occupied No. 35 Park Street for twelve months till it moved into No. 37 on the departure of the Surveyor General's field office in December 1832. The rent then saved was allowed for the field office up country.

In 1834, under a scheme "for the concentration of public offices", the Surveyor General's office was moved to No. 21 Chowringhee Road, a large building just vacated by "the removal of the Courts of Sudder Dewany Adawlat and Nizmut Adawlut" to Alipore. It was first proposed that the office should occupy two rooms in this building whilst "the Sudder Board of Revenue" occupied the remainder. Everest protested that this was insufficient ;

> It is contemplated to lodge the whole of the draftsmen, computers, writers, maps, plans, records, and instruments, in two long rooms on the upper floor of the house. ... The proposed arrangement is totally unfit. ...
>
> In the first place two rooms, ... large and well lighted, are indispensably requisite for the draftsmen alone. ...
>
> 2ndly. One room is necessary for the computers of the Great Trigonometrical Survey. ... To ensure that accuracy which is so indispensable in scientific computations, the persons engaged upon them must be kept quite apart from the bustle and confusion of a public office. ...
>
> 3rdly. One room is required for the writers...preparing copies of fieldbooks and journals for the Honorable the Court of Directors, and in the ordinary...business of the office.
>
> 4thly. One room, and that a large one, is required for the very extensive collection of maps, plans, charts, fieldbooks, journals, and office records. ...
>
> 5thly. One room is required for the depot of instruments...and
>
> 6thly. When I return to Calcutta, which I am liable to do at an hour's notice, ... I will require...two rooms for my own use, one in which to transact my official business, another adjoining it for my library without which at hand I am powerless. ...
>
> With less than 7 rooms it will be utterly impossible to carry on the ordinary duties of the Surveyor General's office, but...in a scientific department such as mine certain extra space is required for conducting experiments and operations. ...
>
> In Park Street...premises it was found...necessary...to enlarge them by enclosing the whole of a spacious verandah on the ground floor and dividing it off into three separate rooms, one of which was required for the reception of an astronomical clock and pendulums sent out by the Hon'ble Court of Directors, the experiments connected with which are still...incomplete. ... The second room was required for the standard bar and scale comparisons ; the third for ...a turning lathe and other tools...which are in constant use in the workshop. ...
>
> The scientific experiments which have frequently to be made...cannot be carried on upon the upper floor of any house, however spacious and ample. ... My operations should be conducted on the solid ground, or equally solid floor of the house[1].

The move to No. 21 was effected before 1st August 1835, and in 1837 the observatory was settled into a substantial building erected in the grounds, the time signals to the Fort semaphore being closed down for nearly two years [114][2]. In discussing other arrangements Everest had suggested that De Penning should obtain consent "from Mr. John Abbott of Alexander's late firm [331 n.1]. ... If you succeed in talking over Mr. Abbott, you will be a wonderful person, for he is a screw of great power".

The accommodation now allotted in No. 21 comprised

> all the rooms on the ground floor, ... 15 in number, together with the adjoining upper-roomed house...on the north, ... also outhouses. ...
>
> There is a spacious room...on the south side, and which, by having so many doors...glazed, is admirably adapted for the drawing department, but unluckily the Committee...have fixed a ladder...in the most important part of the room (only for...admitting a few native petitioners and others to the upper apartments occupied by the Revenue Board), in consequence of which the utility of this grand room is completely destroyed. ...
>
> For the space of a whole month and upwards...the duties of the draftsmen have been greatly retarded owing to the torrents of water that pour down the hatchway cut in the roof for the reception of this ladder, which leading to an open verandah above is completely exposed to the rain, especially when the wind blows from the south or east. ... What security have we for the many expensive little articles in constant use with the draftsmen while a free admittance

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[1] DDn. 289 (246–9), 27–6–35. [2] *v.* frpce., sketch *Gt Arc Tables*.

> is opened into the department from above, tho' everything may be securely locked without ? I stated the inconvenience...to the Committee, and earnestly entreated that the ladder may be removed ; ... the ladder remains to this day an eyesore, and a great annoyance[1].

In 1837 the Revenue Board were given several rooms from the Surveyor General's office, which had to be moved once more, this time to a neighbouring house to the east belonging to Babu Radambub Banerjee[2]. De Penning had to ask for a number of alterations, and reported in September 1838 that he tried to move

> into the new house on the 1st instant by removing first the computing department with all its materials, but in doing so I find...that the house is insufficient to accommodate the whole establishment, and, therefore, the drawing department with all its bulky materials must be allowed to remain in its present position until the new work...is completely finished[3].

Room had also to be found in the new building for the staff of the Deputy Surveyor General, till then accommodated at his private residence. The rent for this new building was Rs. 300 a month.

CLERKS

In 1832 the clerks of the Surveyor General's office were split into three groups—the first accompanied the Deputy Surveyor General to Allahābād, with Alexander Botello as accountant and Peter Dias as writer [345]—the second under the Registrar, Charles Morrison, went to Mussoorie as the Surveyor General's field office, with Joseph Dias as head writer, and two junior writers, James Mulheran and A. B. Ross, engaged just before the party left Calcutta [165, 170]—whilst the third group remained in Calcutta under De Penning [314].

Morrison left Calcutta in December 1832 and reached Mussoorie five months later [170–2]. There were frequent changes amongst the junior writers. Starting pay was Rs. 45 a month. The Registrar drew Rs. 400, and the head writer 150. These sums included an extra 50% over their Calcutta salaries to cover travelling and extra cost of living. The office remained in Mussoorie for the first cold weather, but had to move down to Dehra at the end of February 1834, owing to an order prohibiting the holding of any government office in the hills [165][4].

Pressed with correspondence, the Surveyor General called Dias and Ross to Delhi [34]. Dias protested that he had "taken a house for a twelvemonth on a monthly rent of Rs. 30", and he could neither take his wife with him, nor leave her alone in Mussoorie. Everest asked for his discharge, in spite of 16 years service ;

> Mr. Dias receives...an addition of one half to the salary he drew in Calcutta, and consequently as a mere writer his pay is an enormous charge to Government.
>
> My recommendation is that I...dismiss Mr. Dias immediately, and engage two writers for the salary he draws, viz., 100 sa. Rs. per month, and 50 sa. Rs. travelling expenses. There are so many letters lying uncopied, and so many lying unanswered, that even if Mr. Dias were disposed to obey my orders, it would not be possible to bring up the arrears...without an additional number of hired writers, but with Mr. Dias contumacious himself, and holding out an example to others how to set the Surveyor General at defiance, the arrears...will certainly increase into a frightful mass[5] [343, 345].

On hearing this Dias explained that he would never have disobeyed except for the near approach of his wife's confinement, and Everest then withdrew his recommendation. Meanwhile Dias had provoked a quarrel with the Registrar, who had faulted him for absence from duty. An unseemly disturbance took place in office, involving open defiance of the Registrar's authority[6]. Everest once more asked for his discharge, which Government duly sanctioned, refusing his plea to resign. According to Morrison, the main reason for Dias's behaviour was that his move from Mussoorie

> would cause a loss of 80 Rs. a month...which...he was earning...by giving lessons in music. ... His intention is to set up as a professor of music, having already got some pupils. ... When

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[1] from De Penning, DDn. 303 (679), 12–9–35. [2] vacated by Colvin [III. 205 n.7]; probably 3 Chowringhee Lane. [3] DDn. 352 (207–8) 3–9–38. [4] BMC., 17–10–33. [5] DDn. 286 (114–5), 16–2–34.
[6] Reports make amusing reading : Dias complains of Morrison's threat to "kick me by the Arse".

the office was removed to Dehra, as he could procure no quarter and had not a tent, I gave him a room in my bungalow, but his never ceasing practice on the violin proved to be such a nuisance that I was compelled to request him to provide himself with quarters elsewhere[1].

The gentlemen of Landour and Mussoorie, by some of whom he was employed at that time, had promised to make up among them a sum equal to 300 sa. Rs. a month...if he would resign his situation, and give up all his time as a musician to them and their families[2].

In place of Dias, George Webb was appointed head writer in July 1834[3], and John Driberg took the place of Mulheran who had attracted Everest's attention and was admitted as sub-assistant at the end of April [384], followed by Driberg a few months later. James Nicolson was appointed writer in October 1835 and admitted sub-assistant in August 1836. George Scott was appointed in August 1835, and J. Sheels [Shiells ?] employed between April and August 1836.

When Morrison asked for leave to England, the Surveyor General—having always found him " a clear-headed and acute man of business ", and putting " great reliance in your integrity and regard for truth " — insisted that his " locum-tenens... must in these respects be in no way inferior"[4]. Government ruled that he was not entitled to furlough, but that if he resigned on account of health his post would be kept open for him. Webb's health preventing him from taking over as Registrar, Everest reported that

after much search I found out a person named Harris, Pay Sergt. in the 3rd Troop, 2nd Bde., of Horse Artillery, who bore an exceedingly high character with all the officers under whom he had served. ... Sergeant Harris obtained leave from...the Meerut Division, and joined my headquarters on the 23rd September[5].

An agreement was then signed by Harris and Morrison that for three years from 1st November 1838 Harris should draw Rs. 229, exactly half of the Registrar's salary, the remainder being drawn by Morrison. Harris was extremely hurt that he was granted *no* salary whatever for the six weeks overlap before Morrison's departure, and Everest had also to appease Webb ;

It has caused me as much uneasiness as it has to you to be under the necessity of introducing a stranger to act as Mr. Morrison's locum-tenens to your detriment.

Not only have you given me the fullest reason to be satisfied with your zeal, efficiency, intelligence, and attention to your duty, but your mild and obliging disposition has endeared you generally throughout my department. ... But your health...has been in so precarious a state for the last twelve-month as to place your existence at hazard. ...

To install you as Mr. Morrison's substitute would have been no remedy for the evil, for I should thereby have only replaced one sick Registrar for another[6].

As it turned out, Webb had to take sick leave from September 1839 and did not rejoin till July the following year. Scott also, the second writer, was sick for several months, and had been guilty of "misconduct and reckless imprudence". In 1841, therefore, the staff at Dehra comprised—Harris, officiating Registrar, salary Rs. 458-0-3, of which Morrison was drawing Rs. 229—Webb, head writer, Rs. 127—Scott, writer, Rs. 73-7.

Though Morrison was due back at Dehra Dūn by 1st November 1841, he did not reach Calcutta until late that month, and though he received official sanction to rejoin his appointment, he demanded employment at Calcutta. At the same time he sent abusive letters to the Surveyor General which were described by Government as "of so wild and extravagant a nature that His Lordship in Council considers it unnecessary to take any notice of them", and authorized the Surveyor General to make the best arrangements he could for filling the post of Registrar[7]. Both Harris and Webb pressed their claims, which Everest found

so equally balanced as to render a selection difficult. I preferred to allow them to draw lots as the fairest mode for both parties. Fortune has decided in favour of Mr. Webb, who I beg to recommend may be nominated as Registrar and Accountant, and Mr. Harris as head writer, from the 1st November 1841[8].

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[1] DDn. 288 (135-41), 24-4-34. [2] DDn. 286 (132-3), 14-5-34. [3] Dias disch. 8-5-34. [4] DDn. 348 (36-8), 28-1-38. [5] DDn. 342 (242-3), 11-10-38. [6] DDn. 348 (348-9), 1-11-38. [7] SG. to Mil Dept., 7-12-41, DDn. 402 (1835) ; reply to SG., DDn. 401 (100-1), 29-12-41 ; Morrison sent copies of his letters to C-in-C. and other officers ; he accused Everest of 79 misdeeds spread over many years ; Everest insisted giving crushing replies to every one. [8] DDn. 402 (241-2), 17-1-42.

Harris naturally resigned, but Webb did excellent service for another 20 years and more, starting on Rs. 300 plus Rs. 100 field allowance. He had drawn Rs. 54 on joining in 1834, inclusive of the extra half-pay.

DRAUGHTSMEN

When Everest left Calcutta at the end of 1832 the drawing office was under charge of John Graham, who had been head draughtsman since 1827[1]. Among the European and "East Indian" draughtsmen whose names appear on the many beautiful maps of this period are C. K. Hudson, who was transferred to Assam in October [200-1][2], Breton, McReddie, Rodriguez, William and Edward Wilson, and Winston—and among the Indians, Abdul Khadar, Khadam Ali, Maniruddin, Mian Jan, Rahim Bucksh. Starting salary was Rs. 16 for the Indians and Rs. 20 for the others [III, 314].

Under an order of 1829 three extra temporary draughtsmen were allowed on total pay not exceeding Rs. 100 [III, 311], and Government now directed that,

> as the various departments...will in future be supplied with such portions of the printed Atlas... as may be available, the demand for maps from your department...will become so exceedingly limited...that the necessity of hiring extra draftsmen will be altogether superseded. ... This system is, therefore, to be discontinued, and all extra work...is to be done by the job[3] [III, 292 ; IV, 336].

The Surveyor General saw "no objection...to extra work being performed by contract", but as late as 1840 Rs. 100 a month was still being drawn by contingent bill for the pay of three extra men[4]. The slow trickle of Atlas sheets [304] in no way met the increased demand for maps and pressure of work in the drawing office never slackened.

Everest took with him to the field W. H. Scott, son of the Madras School usher [II, 341] and John Cornelius, who had been with Norris in Nāgpur [III, 93]. Winston, who had long been on the revenue survey establishment [III, 372], was kept at Calcutta for a few months when the Deputy Surveyor General moved to Allahābād [345-6], and Everest acknowledges

> the able assistance which he rendered me in compiling the map of the countries bordering on the Caspian [293]. [He] is now engaged in compiling a map for the Court of Directors from materials collected by me at my private expence [336], combined with other data in this office, and his loss would be very severely felt[5].

G. H. Stapleton was engaged on a temporary basis at Rs. 80 a month

> for the completion of the 5th and 6th volumes of the General Report of the Great Trigonometrical Survey [III, 256 ; IV, 111]. ... He is an engraver and a lithographer, writes a splendid hand, prints beautifully, draws tastily, and is withal exceedingly docile and tractable.

Everest's request to instal him in the drawing office with presses was refused, though he had already complained of the poor work of the Government Press, and had been obliged to give work "to Mr. Tassin...at a considerable expense" [311-2].

> Mr. Stapleton has presses of his own for...striking off impressions both from stone and copper. ... Mr. De Penning will allot one or more of the vacant rooms of this office, which will be disposable after the 15th of December [1832] for the reception of his presses. ...
>
> I propose that Mr. Stapleton should have a salary of Rs. 130 sa. rupees per month, with a native establishment...of 22 sa. rupees per month. ... He is to...perform all the duties of the press when required, and when not so engaged to employ himself just as any other draftsman... under the orders of Mr. De Penning[6]. ...

Stapleton was later employed at the Government Press [350].

De Penning was left in general charge at Calcutta ;

> I recommend Mr. Graham, the Head Draughtsman, ... particulary to your notice...as a person in whose intelligence and zeal I place great confidence. ... Consult with him in any arrangements you make respecting...business for the draftsmen. ...

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[1] Salary, Dec. 1834, *sa.* Rs. 323, or *st.* Rs. 337-8-11. [2] place filled by D. H. Chill, dism. from Rev. Svy. [387, 391]. [3] DDn. 263 (318-20), 23-9-31. [4] DDn. 355 (326-9), 30-9-40. [5] DDn. 283 (217-24), 24-11-32. [6] ib. (228-31), 8-12-32.

Be kind to all my people, but not lax ; strict in matters of duty, but indulgent wherever you can with propriety. Keep it constantly in remembrance that men never work half so well as when their hearts go with their hands. It is an old proverb, and a true one, that you may drive a horse to the water, but you cannot make him drink[1].

Two of the Madras draughtsmen were brought up in 1835, William McVicars, and Charles Joseph, "a native of Tranquebar" [III, 321], whom Everest notes

as very clever as a draftsman. I am told [he] understands...the plane-table, and is on the whole a very useful person. ... He is likely to be an acquisition, ... and I should recommend his being transferred to this Presidency in his present salary, viz., Rs. 87-8 per month, with a prospect of higher pay according to qualifications and good conduct[2].

The other Madras draughtsmen, including Christian Ignatio, the head draughtsman [III, 316], were found work with the Chief Engineer there, who writes that

it will be indispensably necessary to retain one or two of them, and the moochie, as the documents in the Survey Branch deposited at this Presidency are of a most valuable and important nature, and must be under a special charge and responsibility. They must be constantly examined, and repaired whenever damaged by insects, which is unavoidable.

Copies will occasionally be called for by the superior authorities, and requisitions from the Revenue Officers...will sometimes be made, for, although the Honorable Court of Directors consider the Atlas map which is sent out in sectional numbers fit to meet all demands of this nature [335], such is by no means the case, as this work is deficient in detail. ...

I recommend that Mr. C. Ignatio, whom the Government have objected to pension while not incapacitated, may be retained. ... He is a very old and faithful public servant, and the fittest person to have the charge of keeping the maps...in proper preservation[3].

The Calcutta roll of November 1834 shows

D. H. Chill [III, 371 ; IV, 387]
G. K. McReady [III, 314 ; IV, 335]
Wm. Wilson [III, 372 ; IV, 475]
M. H. Dias
Ed. Wilson
E. R. Boileau [106-7, 371-2]

P. H. Neil
Khadam Ally
Armuddin
Ruheem Buksh
Abdul Khadar
Ghoolam Nukee

Musrut Hoosein
Khadeem Hoosein
G. H. Stapleton
Thos. Taylor
H. R. Chill
E. Potter

Amongst the jobs in hand were—Compilation of Capt. Webb's routes in Oudh [II, 33-4]—compilation, Benares Division—examining Nāgpur sections [III, 93]—compilation of Everest's route, Chunār to Hyderābād [III, 353]—copying Capt. Wilcox's reduced map of the Brahmaputra [III, 64].—copying catalogue of maps for Court of Directors—assisting in the correspondence branch.

The more promising men were constantly leaving for more lucrative work ;

The recent resignation of three draftsmen...in consequence of their labours being so ill remunerated, ... and the expected resignation...of 3 or 4 more...whose services...are extremely valuable, ... make me...apply to you for aid to arrest the further progress of this evil. ... The only remedy...[is] to sanction a moderate increase to their present low salaries. ...

Draftsmen may be divided into two classes, viz., *compilers* and *copyists*. The duties of the former are complicated, and require...intelligence and discrimination, and knowledge of the...pentagraph, how to protract routes, and make maps from fieldbooks. They not only compile maps but copy them [300].

Those of the latter are simply to make fair copies from the maps compiled. The salaries of copyists should be regulated according to the neatness and style of their work, and of the compilers in proportion to their usefulness. ...

During the years 1828-29-30, when the offices of the Surveyor General and Superintendent of Revenue Surveys were united, ... the lowest pay of an ordinary draftsman was 50 rupees, of an apprentice 60 rupees, and of compilers from 150 to 250 rupees a month. In order to explain how very differently the same degrees of intelligence and labour were rewarded in this office, and how they are appreciated in others ; ...

Mr. Moffat received in this office Rs.	40 ;	his present salary (elsewhere) is Rs.		125
,, E. Boileau ...	... 29	,,	...	... 100
,, H. R. Chill ...	... 16	,,	...	... 75

De Penning recommended increases aggregating Rs. 150, "the salary of a single draftsman, Mr. [Wm.] Wilson, ... who quitted this office 17 months since, to join Captain Bedford at Allahābād" [183, 475][4] ;

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[1] DDn. 266 (249-52), 19-12-32. [2] DDn. 286 (93-6), 14-10-33. [3] from Wm. Garrard [II, 399]; DDn. 285 (170-1), 5-12-34. [4] DDn. 307 (118-21), De Penning to SG., 16-12-34.

> The order authorizing a charge of 600 rupees per mensem...for draftsmen is dated so far back as the 12th June 1788, nearly half a century ago (vide Carroll's Code, Ch. LXV, Section 20) [II, 274 n.3 ; III, 311], when the materials...and the duties of this office amounted scarcely to one-third of what they are at present[1].

Everest's repeated appeals to Government brought no redress, and he wrote again two years later that

> it is melancholy to witness the rapid decadence of the drawing department. ... All the valuable draftsmen have now taken their departure ; ... those who remain either hang on as a sort of pis-aller until they can get better employment, or wait until—at the expence of the pens, ink, paper, and other drawing materials of the State—they shall have perfected their style so as to enable them to follow a like course[2].

Government replied that they were

> averse to any revival of your office establishment while a considerable portion of it is absent from the Presidency. In the meantime you are at liberty to fill the vacancies occasioned by resignations, either by promoting individuals now in your office, or by entertaining an equal number of others, on terms that will not occasion any expense beyond the authorized charge[3].

Everest had in the meanwhile been successful in obtaining increments to Scott and Cornelius at his field headquarters, where

> Scott is the only person at my command who can assist me effectually in constructing plans. ... His father died in the service of the...Company, having been...for all the early part of his life as assistant surveyor under Colonel Mackenzie, by whom he was first brought to Calcutta, and at the time of his death was tutor of Revenue Survey apprentices under Lieutenant Colonel Hodgson[4] [II, 441 ; III, 501–2].

In June 1841 Scott was drawing Rs. 225 a month, and Cornelius 120, whilst Sheikh Abdul Khadar had been brought up from Calcutta on Rs. 60[5].

Under pressure from the so-called Survey Committee [297–302] Bedford was struggling to recruit capable men, but had to report that he could find no "compiling draftsmen...at present available in Calcutta". Even untrained apprentices could not be recruited from the Upper Orphan School "for less than 50 or 60 rupees each in the first instance"[6].

In spite of all difficulties the outturn of the drawing office was very large and mostly of first-class quality, due mainly to the supervision of Bedford, De Penning, and Graham. Everest wrote on his departure that it would have been

> utterly impossible for me to conduct the duties of the Drawing Department but for the valuable aid of Mr. Graham. ... The geographical materials...have for the last 11 years been sent to the India House in as complete a state as if I had been personally present[7].

COMPUTERS

One of the important problems Everest had to face on his return was the organization of an efficient body of computers, not only for current work but to bring up arrears from the last two years of Lambton's observations, and those of Olliver and himself between 1822 and 1830 [3, 107].

Lambton had never kept any separate staff of computers, his computations being carried out by himself and his assistant surveyors in the intervals between field work. Very often his whole establishment remained at headquarters for more than twelve months at a time [III, 237, 255]. For his own work Everest had only found time for computations when taking shelter from the rains or for his health's sake, and the published account of the Bīdar–Sironj arc was far from complete [III, 257 ; IV, 112–3].

A computing establishment distinct from the field staff was now of the greatest importance though each field party would be expected to take out their angles and set up their triangles [108]. In order, therefore, "to have all the arrears of calculations...brought up, and any future accumulation prevented", Everest requested

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[1] DDn. 311 (42–6), 13–2–36. [2] DDn. 286 (252–3), 10–5–36. [3] DDn. 341 (21½), 6–6–36. [4] DDn. 402 (101–2), 4–8–40. [5] including 50% extra on Calcutta rates [333]. [6] DDn. 355 (326–9), 30–9–40. [7] DDn. 453 (106), 13–12–43.

1st. The appointment of a head computer and a deputy, each on respectable salaries.

2nd. Authority...to engage and train up a certain number of young native computers at salaries varying 30 to 100 rupees. ... Lads thus engaged would be required to possess at starting a competent knowledge of arithmetic, of the practical use of logarithms, and of English. ... I should suggest that the number...be fixed at 8.

In respect to the head computer, I know of no person so well qualified...as Mr. Joshua De Penning, who was at the head of the office of the Great Trigonometrical Survey in the lifetime of Lieutenant Colonel Lambton. That person is still in the prime of life and vigorous, and is highly spoken of by Captain Montgomerie...in whose office he is now employed [III, 380].

He would not consent to reside in Calcutta and undertake the office in question with a less salary than 400 rupees, clear of the pension which he at present enjoys[1].

Government agreed in principle but wanted detailed estimates, and fondly hoped that "all the requisite computers may be drawn from existing establishments under this Presidency". Everest pointed out that

Mr. De Penning...would...be immediately effective, both practically in the sort of computations required, ... and as an instructor for the people who were to act under his guidance. ... Mr. De Penning has been trained up in the same school, and under the same system, as myself. ... He will comprehend my directions better than a stranger could. ... Time will therefore be saved in the outset, and many blunders will assuredly be spared. ...

In the...Great Trigonometrical Survey there are two very able persons, Mr. Olliver and Mr. Rossenrode, either of whom might perhaps answer the purpose, but they are so useful in their present capacity and indeed so indispensible to the field operations, that to remove them would be an inconvenience of a most serious nature. Besides which, ... neither of them would form so good a head of office as Mr. De Penning. ...

The period of training...under Mr. De Penning's tuition...will probably be much shorter than under any other person, ... and...in six months the whole may be in full operation.

It was the opinion of Lieut. Colonel Lambton that...one party in the field would in the course of 4 months furnish matter for 8 months computation [III, 255], but...under his system there was no office in the field, so that not even the angle-books were regularly brought up, and this, I believe, is also the practice in the Great Trigonometrical Survey of Ireland.

When I succeeded, I introduced the system of drawing up all the angles—and computing all the spherical excesses, the chord corrections, the principal and some secondary triangles—... in the field, ... and on that plea an office tent and 2 camels were placed at my disposal [III, 256]. By this means I was enabled to reduce the...indoor work to...about 6 months for every 6 months field operations, but the office tent having been withdrawn...I conclude the estimate of Colonel Lambton must now be considered as the true one. ...

When a party returns from the field they cannot engage in active computation immediately and...when preparing to take the field a great interruption is necessarily incurred. One month in twelve is perhaps lost in this way. ...

If the party in the field...confined themselves to the computations which I have specified, ... and send their materials and field-books to the office [108], two computers under an active and intelligent person like Mr. De Penning would bring up all the indoors work, ... and so prevent any future accumulation of arrears.

Finally; ... 1st. The arrears of computations, with the establishment I have recommended, ... will be brought up in about 2 years and 10 months. 2nd. ... Two additional computers for every party in the field will...prevent further accumulation of arrears[2].

The computing office was sanctioned and established in No. 35 Park Street [332]. De Penning reached Calcutta about 20th November 1831, and in accepting the appointment particularly emphasized Everest's promise that

'You will never be required to go into the field without your own consent, or to go further from Calcutta than the place where the office is established'. ... This was the only temptation that induced me to forsake house and home, and come out an adventurer in a strange land. Nothing shall be wanting on my part...and, while I am assiduously labouring with heart and strength to serve you, I trust that on your part you will protect me and mine[3].

Offers of employment[4] were sent out to a number of Bengali students, the terms being Rs. 30 a month whilst on probation for six months, with prospective posts—1 Principal Computer, Rs. 100—1 Deputy, do., Rs. 60—6 Computers, @ Rs. 40. De Penning was Chief Computer, and Peyton his Deputy. Amongst the probationers "Radanath Sukdhara" accepted appointment on 19th December 1831[1], and a few months later was appointed sub-assistant in the G.T.S. [371], Everest declaring that he was

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[1] DDn. 265 (147–53), 4–2–31. [2] ib. (236–8), 18–8–31. [3] Family papers, De Penning to SG., 28–11–31. [4] DDn. 267 (92–3), 17–12–31.

> the ablest pupil that the Hindoo College has yet produced, and his mathematical acquirements are of a superior order ; whether he will turn out to be practically efficient is a question. ... I propose dispensing with the ordinary articles of agreement until the lad has had a trial of the kind of life in which he is about to be engaged[2].

De Penning was not long in getting the office into good shape, but Everest was scandalized at the dress worn during the Calcutta rains ;

> It is not considered amongst the English consistent with decorum to enter an apartment destined either to business or domestic affairs without such...dress as is simply sufficient to cover the nakedness of the person. In points essential to their religion or the...habits of their country, I shall carefully abstain from interfering, ... but in such as are not at variance with these, I have a right to expect that they will in their turn comply with my wishes.
>
> It is not at variance with these notions to wear a pair of clean stockings, and clean well-blacked shoes, neither does it at all war with any of their habits, ... that I am aware of, to wear trousers or paijammahs[3]. It is my desire, therefore, that these young men when attending office conform to these parts of dress which in my eyes are essential to decency.

He suggested that a special work room might be set aside for those who found themselves unable to meet his wishes[4].

By the end of the year De Penning had 8 computers under training, @ Rs. 40 a month :

Shivchunder Deva	Rajnarain Bysack.	Madhubchunder Mullick
Jadub Chunder Set	Kallycoomer Bose	Radhanath Bose.
Nilcomul Ghose	Gooroochurn Dass	

> They are making rapid progress in computing and filling up the forms for latitude, azimuths, etc., completing 5 and sometimes 6 in a day. Mr. Rees [III, 496] is...examining their work. ...
>
> The latitude, azimuth, and longitude, of all principal stations in the section Takalkhera and Kulliampoor have been computed. ...
>
> The secondary triangles of the section Takalkhera and Daumergidda will soon be completed, and I am preparing to send up to Agra copies of the Register of triangles, latitudes, longitudes, etc. The Plan to accompany your copy of the Report is nearly ready. It requires examination, and the insertion of such points as may have been omitted by the draftsmen. ...
>
> As there is very little hope that Government will sanction the establishment of a lithographic press in your office...I may get the forms...for the next Report struck off at the Government Lithographic Press [108, 312–3][5].

Peyton had accompanied the Surveyor General up country, so, except for Rees, De Penning had no one of any experience to help him [III, 496 ; IV, 114]. It cannot, therefore, have been very encouraging to hear from Everest that

> it is the duty of the Chief Computer to examine the computations, and it was upon the faith of your peculiar fitness for that office that Government acceded to your nomination. It is not everybody in whom I repose that confidence, and without meaning...to disparage the qualifications of Mr. Rees, ... my acquaintance with him is far too recent and too limited to allow of my staking so much on his responsibility[6].

De Penning regretted that he should be blamed

> for allowing Mr. Rees to examine the computations. ... Mr. Rees was merely allowed to run over the sines and co-sines of the azimuths as a means of keeping him employed while he attended office, and having nothing to do. ... In all that laborious calculation, not a single error, even to the last figure in the logarithm, was detected, much to the annoyance of Mr. Rees[7].

He was just too optimistic, and two months later had to accept a correction ;

> The error is trifling, as you...observe, for it will not affect more than the 3rd decimal ; but it is no less an error for all that. ... At the time those azimuths were computed the...office was crowded with upwards of a dozen wild apprentices, to keep whom and the 8 computers fully employed, and to preserve order and subordination, my time was much occupied.
>
> Moreover, there was the 3 copies of the Reports and Plans to be prepared, so that...I requested Mr. Rees to run over the sines and co-sines, ... for it was there I apprehended any error might creep in, ... but some how this error escaped Mr. Rees.

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[1] DDn. 264 (309), 19-12-31. [2] DDn. 283 (70-1), 30-4-32. [3] instead of the *dhoti* of Bengal. [4] DDn. 266 (192-3), 16-7-32. [5] DDn. 303 (45), 1-3-33. [6] DDn. 317 (28-30). 14-6-33. [7] DDn. 303 (181), 4-7-33.

> I am glad the error has been detected and pointed out. It has afforded me a very good opportunity of pointing out to the computers the necessity of observing great caution in their future computations, and Nil Comul Ghose...is much distressed at the error. He is one of the best computers. ... He is the only computer that can make out the azimuths when I am otherwise occupied. ... Our future computations will bear the most rigorous examination[1].

Rees had originally been entertained for work in the observatory [III, 188]. He suffered from a nervous twitch that prevented any useful work in the field, and had now returned from leave. He had agreed that during this leave, up to three years, half his salary should be paid to his substitute, George Logan, who had been engaged up to February 1834. On Rees' return within two years, the Surveyor General reported that Logan, who had accompanied him up country, had proved

> extremely useful, ... both as an observer, a computer, and field assistant. ... The contemplated result of Mr. Rees' visit to his native country has not...been realized. ... His health has not been restored; ... he can be but partially efficient. His expectations...are that at the expiration of 3 years he should come into the possession of his full salary, amounting with the authorized increase of one third for field allowance, to 400 rupees per month.
>
> That sum is at present distributed monthly—Mr. Rees, Rs. 150—Mr. Logan Rs. 250—and in consideration of Mr. Logan's utility, I should...recommend that from February 1834...he be appointed an assistant to the G.T. Survey, with a salary...Rs. 250 per month [353, 380][2].

Though Everest regretted that he could not have the computing office under his immediate eye, he knew De Penning's worth;

> These computations become now deeply interesting to me, as you may well suppose, and now I feel the value and importance of a steady person like you, and am quite assured of the judgement I observed in selecting you. I wish it could be settled that the computing office and all the establishment could come to this fine climate, but there are many difficulties in the way, and not the least is your own reluctance to quit that amiable spot, Calcutta[3].

In March 1835 the seven Bengali computers[4] who still drew only Rs. 40 each begged for an increase of salary, pointing out that "every one of us has a pretty large family to support". De Penning particularly commended Nil Comul Ghose, who was now helping Rees in the observatory [114], and had

> fully qualified himself for all the arduous calculations of the Trigonometrical Survey, and is now competent to deduce the azimuths, and to examine the field books. ... In fact, to do justice to the Hindoo computers, I must say that all of them are equally attentive to their duties, and strive to the utmost to afford me every assistance, but Nil Comul has, by greater application, got the start of the others[5].

Everest made cautious reply;

> It is abundantly gratifying to me to hear such good accounts of you; ... I will do my utmost to...promote your interests. ... It has ever been my attempt to apply to my own darling profession, the Great Trigonometrical Survey of India, ... perfect fairness and impartiality.
>
> You cannot each and all be chief native computers. Nil Comul Ghose stands particularly recommended. ... I have accordingly recommended Nil Comul Ghose for this situation. ... I have no power to increase any of your salaries beyond the limits first assigned; that is the affair of Government, but I have not failed to draw attention...to this subject. ...
>
> As to...wives and families, it is a question which must be arranged with Dr. Malthus[6]. ...
>
> Your fellow collegian, Radanauth, is high in favour with everybody, and universally beloved in the G.T. Survey. You will not know him for the same person when you see him again, for he is no longer a puny stripling, but a hardy energetic young man, ready to undergo any fatigue, and acquire a practical knowledge of all parts of his profession. ...
>
> There are few of my instruments which he cannot manage; and none of my computations of which he is not thoroughly master. ... Eventually he will furnish a convincing proof that the aptitude of your countrymen for the practical, as well as the theoretical, parts of mathematics is in no wise inferior to that of Europeans[7].

Nil Comul Ghose was promoted to Rs. 100, but the remainder were still drawing only Rs. 40 a month in 1838, when—with one exception—they all left to accept newly established posts as Deputy Collectors in the revenue department[8], and—again with one exception—giving the Surveyor General no previous notice;

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[1] DDn. 303 (273), 2-9-33. [2] DDn. 286 (52-4), 24-8-33. [3] DDn. 287 (63-5), 20-6-33. [4] Kali Kumar Bose having dropped out. [5] DDn. 303 (515), 12-3-35. [6] Thomas Robert Malthus (1766-1834) the celebrated protagonist of birth control; *DNB*. [7] DDn. 289 (221-2), 2-4-35. [8] Depy. Collrs., Balasore & Bakarganj: Rayarain Bysack; Sibchandra Deb; Radhanath Bose; *Ben Dir & AR.*, 1845 (62).

I see no remedy. ... We cannot expect young men to work in my office for the fun of the thing at 40 rupees per month when they can get 300 elsewhere. The only way is to supply the places of those removed, and I authorise you...to engage suitable persons. ...

You may tell these youths, Gurucharn excepted, that the good fortune which has attended them would caused me much more gratification if they had paid more attention at their exit to the common courtesies of life. It has been my study to have them treated with kindness and consideration, and not one of them, save Gurucharn, has had so much civility as to thank me at his departure. This is a sorry mode of quitting my patriarchal influence, and shews me that they are yet to learn how to prize the good offices of their superiors[1].

The only one who stayed on was Mahdub Chunder Mullick, and after recruiting a new batch De Penning recommended that he,

as the oldest computer, be promoted to the situation of Nilcomul Ghose, and enjoy the highest rate of salary, 100 rupees, from the date of Nilcomul's departure, to which...he is fully entitled, not only for the length of his service, but for the general good conduct, and the zeal and activity he has displayed since Nilcomul's duties have devolved on him.

That Sreenauth Sicdar[2], who has already made himself exceedingly useful, and is moreover an expert computer, be appointed to the situation recommended for Rajanarrain Bysack, on the salary of 60 rupees per month[3].

With the assistance of Rees, De Penning had now to train a new batch of young computers. He was at the same time distracted by responsibility for the workshop on Barrow's move up country, and also by Graham taking six month's leave from the Drawing Office. It was natural that the progress of the computations suffered, to Everest's great distress. He wrote peremptorily to De Penning ;

1st. The computing office was organized, and you were placed at its head, in 1831 for... facilitating the computations of the G.T. Survey, and the Great Arc in particular. ... No duty whatever is to be executed which is calculated to retard those computations. ...

2nd. You cannot...receive orders, or comply with requisitions, emanating from any other quarters than the office of the Surveyor General...or from the...Secretary or officiating Secretary...Military Department. ...

3rd. I direct you to desist from answering any letters whatever...unless...from my office in the field, or direct from the Government through the prescribed channel. ... Send all letters containing such orders forthwith to me[4].

He passed a copy of De Penning's report to Government ;

The computations...are very urgently required. ... The formulæ and instructions were sent down in September last. ... They...ought to have been completed in 112 days actual work, but...not one third...had been completed in 188 days. ...

This will never do at all. My object in recommending to my Lord Bentinck's Government to organize an establishment of computers was to facilitate all those computations of the G.T. Survey, and of the Great Arc in particular. ... This then...is manifestly the main duty of the computing office, and of Mr. De Penning, ... and...any duty which interferes with this is at variance with the fundamental principle upon which that office is established[5].

On Bedford's appointment as Surveyor General's Deputy at Calcutta, De Penning was left with undisturbed charge of the computing office [100, 325-6].

Following the desertion of the Calcutta computers, Everest was much distressed when Radhanath Sickdhar asked leave to accept a profitable post as "teacher to a public institution" [375][6]. He begged Government to grant him a substantial increase of pay as inducement to stay ;

Of the qualifications of the young man himself I cannot speak too highly. In his mathematical attainments there are few in India, whether European or Native, who can at all compete with him, and...even in Europe those attainments would rank very high.

As a computer he is quite indefatigable, and...there is no person in my Department so thoroughly skilful in the application of the various formulæ. ... These qualifications...so eminently valuable to my Department, would be thrown away upon that to which he now seeks to be transferred, not-but-what he would be infinitely useful in any situation...because he is a clear headed, shrewd, and intelligent person and possesses...activity of body and mind. ...

Computers comparable to Radanath cannot be hired in England at a less price than one guinea per diem, and...persons so qualified would not undertake the business on any terms that could...be offered. ... Habituated as Radanath is not only to apply formulæ, but to

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[1] SG. to De Penning, DDn. 348 (140-3), 15-3-38. [2] Younger bro. to Radhanath. [3] DDn. 352 (150-4), 6-4-38. [4] DDn. 475 (1-4), 25-4-38. [5] DDn. 342 (136), 25-4-38. [6] ib. (113), 18-2-38.

> investigate them, and trained up as he has been from boyhood under my own eye, he would be the cheapest instrument that Government ever could employ in a task of this kind. ...
>
> If...this young man ..quit my Department, ... I should...require...Mr. Rees at my headquarters in the field, but...Mr. Rees would in that case be entitled to...Rs. 104–8 in addition to his present salary, besides...his passage...and camp equipage and carriage furnished at the public expence.
>
> It would take 4 months at least of the most valuable season in the year for computations before Mr. Rees could reach my headquarters. He would probably arrive at Dehra in September, just as my Department was about to take the field. ... Being only a computer he would be of no use to me in the field, ... but from the 1st of October till the 1st of April he would be drawing his whole salary without...advancing the computations one iota. ...
>
> Of Mr. Rees I know nothing. Report speaks highly of him in Calcutta as a mathematician, ... but I have no proof of it, and I put but little faith in...the opinions of the public of Calcutta, because they...are greatly given to admire mediocrity. ... Mr. Rees has not been trained up under me, and when a man passess the age of 40...it will be in vain to look for much... aptitude for learning new systems.

If Rees were brought up from Calcutta, he continued, other arrangements would have to be made for the daily time signals, but all this trouble would be avoided if some increase of salary could be sanctioned for Radhanath Sikdhar[1]. Government was sympathetic and pointed out that the Revenue Board had already been told

> that it was wrong for one department of the State to bid against another for the services of competent officers, ... which...will prevent any repetition of...that which you have deprecated. ...
>
> His Lordship...will be prepared to take into consideration such increase of salary to Radanath Sikdhar as you may conceive to be just and equitable, without advertence, however, to that of any other situation which he may be desirous of obtaining[2].

An increase of Rs. 100 a month was sanctioned, and the Governor General expressed great satisfaction with "the number of native youths who are qualifying themselves by study for useful employment in every department"[3]. The principle that no department should poach on the staff of another was confirmed in due course by the Directors, and holds to this day:

> The Surveyor General's report of Radanath Sickdar's attainments and talents, and of the valuable nature of his services, fully justifies you in granting the increased salary. ... His services will now, we trust, be retained in the department. ...
>
> As it is of much importance that natives who have been trained to the duties of an office, more especially to duties of a scientific nature. ... should not be incited to quit their stations with a view to their own advantage in another branch, ... we fully approve of the intimation given by you to the Revenue Board. ...
>
> Departments...must not only not invite, but must positively refuse to entertain an application for employment from any native who is at the time...in the public employ of a Government office or department, unless they shall have previously received the full acquiescence of the head of such office or department[4].

The new batch of computers soon settled down, but there were occasional complaints, and "absenteeism" was not unknown. De Penning had to report

> Baboo Gopaul Kissen Dutt, who...is very irregular in his attendance at office. ... He absents himself whenever he thinks proper, generally on the plea of sickness, and in the case of holidays, should there be a couple of days in the week, he is sure to take the week to himself. ... No remonstrance or admonition on my part has any effect on him; added to which he is of a very insubordinate disposition, and sets a bad example to the rest of the computers. ...
>
> I have frequently threatened this contumacious Baboo with your displeasure, and at one time I had hopes of a reformation as he...apologized for his error and promised to behave better, ... but, I have been sadly disappointed. Even now...he is absent[5].

During the rains of 1840 the computing office was honoured with a visit from Lord Auckland, and the computers took the opportunity of presenting him with a petition regarding their pay and prospects, sending a copy to the Surveyor General at Mussoorie, to entreat his support. Everest replied that he would

> waive all objections to the irregularity of the channel, and...hail with pleasure any results to your advantage. ... Though I take the deepest interest in native improvement, and view with delight the progress made within the last 20 years by the natives of Bengal, which is without

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[1] DDn. 342 (139–44), 25–4–38. [2] DDn. 341 (255–7), 15–5–38. [3] ib. (274), Simla, 1–6–38 [4] CD to D. Mil., 10–6–40 (13–4). [5] DDn. 307 (338–9), 1–4–40.

> precedent in the history of man, yet I feel myself precluded in this case from taking any part in your behalf, unless consulted by His Lordship in Council[1].

Though he had never had personal touch with these later computers, they, as well as all other members of the department, were fully conscious of his patriarchal regard, and in December 1843 there was a pleasant exchange of greetings between the retiring Surveyor General and the eight computers then serving :

Sreenath Sickdar[2]
Nil Chunder Ghosaul
Jugat Chunder Dev
Radhanath Sen
Motee Chander Chatterjee
Gopee Nath Sen
Bholanath Mazumdar[3]
Shama Charan Bose

Correspondence

One of the great drawbacks in combining the two posts of Surveyor General and Superintendent of the Great Trigonometrical Survey was that no adequate provision was allowed for the close control of subordinate units.

There was quite enough work for the Surveyor General in the general direction and control of his department. But it was asking too much for the same man to organize and administer the operations of the trigonometrical survey, which were no longer, as before 1830, confined to a single chain of triangles. As Superintendent he had not only to build up and equip new establishments of all grades, but, in Everest's case, he had also to execute personally the operations of the master series of the Great Arc—devise new methods to meet new and unthought-of problems—and take a major part in reconnaissance and observations [315-6].

The Surveyor General was responsible for the field survey and mapping of Madras and Bombay, where he had lost his deputies, as well as the now vastly extended presidency of Bengal. He found it quite impossible to give any attention to the many geographical ventures that were continually in progress on and beyond the frontiers. His only remaining official Deputy was removed from his immediate orders, and confined to the full-time task of superintending the revenue surveys of the western provinces. Indeed, whilst he was thus stationed at Allahābād, the very important revenue surveys of the lower provinces and Assam were left entirely without professional direction.

In neither capacity had Everest any staff officer to take a share of the burden. He was overwhelmed with work. He was intensely interested in the detailed working of the trigonometrical branch, and his letters to the Military Department ran to extravagant lengths in his endeavour to state beyond risk of misunderstanding every possible aspect of the professional side. As so many of his propositions entailed considerations of establishment and finance, the replies from Government constantly demanded more discussion and yet more details. Whilst at Calcutta in October 1831, he called attention to

> the voluminous nature of the correspondence of my office, ... quite frightful to contemplate. As copies of all letters must be preserved, as well as the originals of all those which are received, ... a quantity of ponderous documents is thus accumulated. ...
>
> In the first place a great deal of valuable time is...taken up ; in the second...a great deal of expense is incurred ; ... in the third...an establishment of this sort becomes so overloaded with documents as to be totally immoveable ; and in the 4th, ... the Chief of the department is rendered dependent on his Register [Registrar, or supervising clerk], in case of the death or sickness of whom his department is liable...to be utterly paralysed [315-6].
>
> A very great portion of this correspondence arises from the minute written explanations which are called for by His Honor in Council of every measure that I presume to recommend. ... It might...tend to...economy and dispatch if my judgement had...greater scope allowed. ...
>
> The Superintendent of the Great Trigonometrical Survey of Ireland has hardly any official correspondence save with the officers under his authority, and that he curtails as much as possible. When I was...in England, many propositions were submitted by me to the Court of Directors, but written explanations were hardly in any case required of me, and viva-voce communications with the Chairman were deemed to answer all purposes. ...

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[1] DDn. 404 (165-6), Aug. 1840. [2] resd. in 1862. [3] Hd. Computer, 1862-70.

> His Honor in Council has himself assured me that my explanations are never understood, in spite of the...efforts which I make to divest them of all obscurities[1].

To simplify correspondence with field parties he ordered

> all letters addressed to the Surveyor General...to be sent in duplicate...on foolscap paper with half margin. One of these copies will be returned with replies or remarks opposite to the paragraph requiring them. Officers...will...limit the length of their letters as far as practicable by curtailing all expressions not bearing upon the sense of their subject [315][2].

He wrote again to Government ;

> The current business...has vastly increased, whilst the establishment of writers has remained the same. The scientific surveys at Bombay by Lieutenant Shortreed, and in the Nizam's Dominions by Lieutenant Morland [248, 256], have greatly added to my correspondence, ... and what with...the formation of a computing office, the measurement of the baseline, the organization of the trigonometrical parties, ... I shall not be far wrong in estimating the... official writing at full double what it was in the time of my predecessor [316]. ...
>
> I have not as yet deemed it indispensible to apply...for an increase, but...if I do not, ... the business...will fall into arrears as it did in the time of the late Lieutenant Colonel Mackenzie, when letters remained five or six years on the shelf unanswered [III, 304, 477-9][3].

On Everest's first journey up country, separated from his field office for nearly five months, he sent to his Registrar

> two lists, of which that marked A shews what documents are now in my office trunks, and that marked B those data which are indispensible for reference, but are not forthcoming. There is no remedy but to copy correctly all those data and send the copies...to me at Agra, keeping the originals safe until my arrival at Mussoorie. ... Above all things, be most careful that the copies contain no deviations from the originals[4].

Morrison passed the lists to De Penning at Calcutta ;

> The Major wishes the articles specified...sent up to Masuri by the first conductor's fleet that leaves the Presidency— ... Bengal, Madras, and Bombay General Orders—Bengal Code of Regulations—Mackay's Longitudes—Nesbit's Land Surveying—all the old contingent bill books—Bagay's Tables, 1 copy—Huttons Tables of Products[5].

As he became more deeply involved on the Great Arc, Everest became the less able to deal with correspondence from distant field parties [252, 345, 381] ;

> The abolition of the offices of Deputy Surveyor General at Madras and Bombay renders it indispensible to reduce the correspondence...to the smallest possible quantity. ...
>
> You will only write to me in cases where you...cannot proceed without my aid, and—when you cannot avoid making a reference to me—...you will study to make your letters brief, concise, and explicit—your propositions all single and specific—and the handwriting such that it may be read without stopping to spell.
>
> When you require any articles which you think I can furnish, send an indent, ... but... refrain from enumerating them in the body of your letter. If you want articles which I cannot supply, and you know where they are to be procured, a simple statement...will enable me to forward your purpose better than whole reams of verbiage[6].

De Penning was commended ; "I thank you for the precise, clear, and business style of your letter and data. Pray adhere to that, for it saves a world of trouble".

He was insistent on the preservation of normal official channels of correspondence, and was indignant when De Penning dealt with matters at Calcutta that should have been passed up to him up country. Special authority had to be obtained before a junior officer such as De Penning could "frank" official letters or parcels for post "under flying seal" [325] ;

> The slow progress of the dak in India is already a source of great inconvenience, and is an evil of very serious magnitude. Anything that can be done to expedite the business of my office will be a great advantage. ... If my request cannot be complied with, I beg Mr. De Penning may be permitted...to pay the postage of such public letters and parcels as he may transmit to me on emergency, and charge the same in the monthly contingent account[7].

This difficulty was later overcome by De Penning getting his letters and parcels franked by Bedford. So anxious, however, was Everest that De Penning should not be distracted from the duties of the computing office, that he asked Bedford to refrain from addressing him officially, that is, before his official appointment to charge of the Surveyor General's office ;

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[1] DDn. 265 (261-91), 12-10-31. [2] DDn. 578 (58), 10-2-32. [3] due largely to Mackenzie's ill-health ; DDn. 283 (88-96), 21-6-32. [4] Saugor, 4-3-33 ; DDn. 265 (3). [5] DDn. 309 (120), 24-7-33. [6] DDn. 328 ; (166-7), Circular Letter, 15-10-33. [7] DDn. 342 (56½), 18-10-37.

> Mr. De Penning has reported to me that you have addressed letters to him direct. Mr. De Penning is the Head Computer of the office of the Surveyor General of India, and is in the strictest sense of word a subordinate of mine only. ... He has no power to correspond with the Deputy Surveyor General of Bengal, neither has he the means of carrying on such correspondence without neglecting the duties for which...expressly paid. ...
>
> You will never think of addressing Mr. De Penning...through any other channel than that of my office, or without my sanction previously obtained [324–5][1].

In spite of the relief afforded later by the appointment of a Deputy at Calcutta and an Assistant at Dehra, Everest was so deeply engaged in professional work that his correspondence was continually pushed to the side and, writes Bedford,

> Colonel Everest has been busily employed with his astronomical observations at Serong, and recently proceeded (in very indifferent health, I hear) to Delhi. He is never very prompt in replying to letters when in the field, and sickness is a bad quickener[2] [252, 344].

To Government he explains that business had

> fallen seriously into arrears, and crowds upon crowds of important documents still remain on the file in rough draft for want of time to copy and index them. ... I hope you will lay before His Lordship...my earnest solicitation...to engage as many writers as the nature of the new call may demand, and at...not less than 50 rupees, or more than 100 rupees, each [333]. ...
>
> Every letter which arrives and requires an asnwer is detained on the shelf...until I can afford time to attend the subject. Each paragraph is then diligently and carefully read and studied by myself, and...the reply is drafted by me. When the reply is fairly copied it is brought to me for...examination, and as all my official letters have...been...indexed and labelled, the difficulty is greatly abridged.
>
> I...exclude studiously all superfluous expressions, and though I may sometimes unwarily fall into the error of verbosity, yet in general there is hardly a paragraph...which is not fraught with meaning[3] [329].

BENGAL REVENUE SURVEYS ; D.S.G.'S OFFICE

On Bedford's move to Allahābād in 1832 he took Alexander Botello as head writer and accountant [III, 314 n.4]. Botello had been with Hodgson in the same capacity since 1823, and his pay was increased in 1834 from the original 120 to Rs. 150 a month. He was dismissed in August 1837, having already been fined several times for absence without leave. His family had been long established in Calcutta, where he expected to have no difficulty in finding employment[1].

Peter Dias, the junior writer, drew only Rs. 30 after six years in the Department. He had managed in Calcutta "having a brother in the same office and... living with friends", but he could not manage in Allahābād, and had to resign[5].

For charge of his drawing office Bedford took Marcellus Burke, originally an assistant surveyor on the Madras establishment [II, 351, 461 ; III, 371, 384] and he was joined by Winston from Calcutta in June 1833 [335]. Of the three Indian draughtsmen who also went to Allahābād, Piari Lal was temporarily transferred to Lawrence's party in the field in 1834.

On Bedford's transfer to Calcutta at the end of 1837 he left all his staff at Allahābād under the Board of Revenue, and engaged others in Calcutta at a monthly charge of Rs. 724. Those left at Allahābād comprised[6]

Map and Plan Department			*Writing Department*			
Mr. M. Burke, Assist. Surveyor ...	Rs.	337- 8-0	Mr. Roberts, Head Writer	Rs.	130	
Mr. E. Winston ,, ,, ...	,,	206-12-0	Mr. Cazabon, Asst. ,,	,,	50	
Pearce Lall, native draftsman ...	,,	62-11-2	Duftree	,,	8	
Joynarain Biswas ,, ,, ...	,,	62-11-2				
	Rs.	669-10-10		Rs.	188	857-10-10
Miscellaneous		53-14-5.	... Fixed contingent allowance		15,	... Rs. 68-14-5
			Total Monthly Expense ...			Rs. 926-9-3

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[1] DDn. 371 (183-4), 25-4-38. [2] to Morland, 4-2-40 ; DDn. 389 (25-6). [3] DDn. 344 (279-82), 20-11-39. [4] The name appears on a early map of holdings on Sāgar I. ; family still represented in Calcutta in 1945. [5] from DSG., 1-1-34 ; BTC., 10-2-34 (36). [6] ib. 18-10-38 ; BRC., 10-10-39 (2).

This staff was dispersed in May 1839 since, writes Winston,

> the...office is to be remodelled by having only a few draftsmen on small salaries, with a lithographic press to copy each purgunnah in every district separately, duner the superintendence of the Secretary[1].

Bedford was only able to employ Winston in Calcutta,

> Mr. F. Hely has been appointed Head Writer of my office, and relinquished a situation in the Preventive Service [Excise Dept.] of Rs. 150 per mensem ; for Mr. Roberts...there is no chance of any vacancy here. With regard to Messrs. Burke and Winston, the former...from age and bodily infirmities...is incapacitated from...office duties, and is desirous of...pension. ... Mr. Winston I shall be most happy to engage[2].

After acting as instructor [393] Burke was granted pension of Rs. 168–12–3 from December 1842, which he drew at his home town, Madras. When Bedford retired he left his office under charge of the Revenue Board, comprising

> Francis Hely, Head Writer and Accountant—James Botello, Asst. Writer—Edward Winston and Alexander Daniell, Assistant Surveyors, and Walter Graham, draughtsman.

FIELD ESTABLISHMENTS : WESTERN PROVINCES

In preparation for the conference at Allahābād, surveyors were called on to suggest the most suitable organization for a revenue field survey party, and after the conference the following directive was issued to the Board of Revenue ;

> It is obvious that the more the establishment of each Surveyor is strengthened, provided he can efficiently control...it, the more economical it must be to Government. ... But the real economy...must depend on the extent to which natives can be employed, and the...judgement with which they can be instructed. ... Every Surveyor will...direct his particular attention to...this important object [402].
>
> His Lordship in Council has been pleased to sanction...for each of the five surveys, viz.,

1	Surveyor		per mensem Rs.	526
1	Assistant Surveyor		,,	250
2	Junior Surveyors	@ Rs. 100	,,	200
1	Head Native Surveyor		,,	30
25	Native Surveyors	@ Rs. 10 & 20	,,	375
140	Khalassees	@ ,, 4 & 6	,,	700

> Total Rs. 2,281 — Add for Contingencies Rs. 104 — Total per mensem Rs. 2,385[3].

This was the staff provided for the professional survey [212–3], the *amīns* or measurers required for the *khasrah* being separately provided for. Under the old system, responsibility for *khasrah* survey rested with the district revenue authorities, who seldom timed their operations to fit with the professional survey. It was decided at the conference that the professional surveyor should himself manage the *khasrah*, and make it fit in with the professional programme. Arrangements had now to be made for special detachments to carry out *khasrah* survey where professional control had been already completed [211, 215] :

> Independently of the old Goruckpore survey, there are 12,625 square miles surveyed professionally, over a small portion of which only the khasrah measurements have yet extended. If this work is to be brought up there is a wide field for the detached employment of those uncovenanted servants of the Department who are equal to the duty. ...
>
> With...the following native establishment each Sub-Assistant might with ease...accomplish 500 square miles during each season. ...—Sub-Assistant, Rs. 200—Native Establishment for 15 chains, Rs. 375—Contingent Charge for paper, chains, and Mootsuddies' tent, Rs. 52—Total, Rs 1,627. The charge for superintending the *khasrah* arrears may...vary in cost, should it be...advisable to employ some of the uncovenanted Assistant Surveyors in lieu of Sub-Assistants[4].

Bedford spread his staff over six district surveys, allowing the following monthly charges ; "Delhy, Rs. 2,425–6–8—Suharunpoor, 2,475–6–6—Suhuswuan, 2,362–14·6—Moradābād, 2,558–5–4—Agra, 2,415–6–8—Allahābād, 2,174–14–6"[5] [213–4]. In accepting these estimates the Board of Revenue suggested that,

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[1] to DSG., 2–5–39 ; BRC., 10–10–39 (3). [2] from DSG., Calcutta, 11–5–39. [3] BTC., 20–5–33 (44). from DSG., 15–6–33 ; BTC., 2–9 33 (15). [5] from DSG., 17–7–33 ; BTC., 2–9–33 (18).

> in the first instance at least, the whole amount...sanctioned for the native establishment of each survey may be drawn in one sum by the Head of the Survey, to whose discretion the organization...shall be left. The sum to be thus drawn will...in no account exceed the amount sanctioned, and the Surveyor will furnish with each monthly bill a list of the officers entertained, and their respective salaries, certifying on honour to the truth [403, 409]. ...
>
> Much difference of opinion as to the...native establishment. .appears to exist among the Surveyors. ... The first season's operations will show what system is to be preferred[1]

Under the further changes introduced in 1837 certain Surveyors were allowed "double establishment", by which they were able to give greatly increased outturn in the year, reducing their cost-rates by more than a half, but with serious loss of accuracy [215-8].

LOWER PROVINCES

The district surveys of the Lower Provinces had each been started independently, under civil control without any standard pattern of establishment [178-9]. In 1834 Siddons had to raise a party for the survey of Chittagong and

> having communicated with Captain Hodges, and obtained his advice, ... it appears to me that the establishment allowed in the Upper Provinces [346]...would be for this first season...unmanageable...owing to my having to organize and instruct the junior native surveyors, it being impossible to...get men ready trained to surveying...at 10, 15, or even 20 rupees a month. ...
>
> I should recommend the establishment marked B...arranged with reference to the abilities at present procurable by me in Calcutta. ... The Kalasees will be entertained by degrees, ... till the survey is in full operation. ...
>
> B. 1 Senior Sub-Assistant, Rs. 200 — 2 Junior Sub-Assistants, Rs. 200 — 6 Natives @ Rs. 30, Rs. 180 — 70 Kalasees @ Rs. 4 & 6, Rs. 350 — Monthly expence during the season, Rs. 730. The annual expense would be reduced by discharging all except really useful kalasses when they are not so much wanted[2].

Three years later the Board of Revenue put up a statement

> of the establishments composing the different revenue surveys in Bengal. ...
>
> Lieutenant Siddons draws a contract allowance amounting to Rs. 104 per mensem[3] on his permanent establishment in Chittagong, which costs Rs. 971 per mensem, as well as a like allowance on the temporary establishment in the Soonderbuns...for eight months, costing 1,075 per mensem. ... Lieutenant Phillips [198] also draws the same allowance for his establishment, ... Rs. 1,070 per mensem. The above rates...do not include the contract allowance. ...
>
> The establishments of the three remaining officers, ... Egerton, ... Ellis, and...Thuillier, who claim the same allowance, amount respectively to Rs. 743 for the latter, Rs. 504 for Lieutenant Ellis, and Rs. 346 for Lieutenant Egerton.
>
> The Board recommended that the contract allowance for the repair of instruments and tents, which may be fixed...at 100 Company's rupees per mensem, should be granted to every Officer in Charge. ... Surveyors are a class of officers who are very moderately paid in proportion to their acquirements, and to the...labour and exposure expected of them[4] [364].

This contract allowance of Rs. 100 covered

> repair and carriage of office tents, carriage of instruments, repairing and replacing chains, flags, pins, mallets, office tables and stools, office [rent] during rains, country paper, &c., country ink, and other trifling expenses[5].

For the survey of Orissa, Fraser allowed for

> four distinct zillah surveyors—Northern—Central—and Southern—Cuttack, and Hidgellee [185-6]. ... Total for each survey, excluding Surveyor in charge, Rs. 637. The above is the smallest proportion with which the duty can be efficiently carried on, being about one half of that used in the North West Provinces, and it is probable that when the surveyor is well acquainted with his work, he will find employment for a much larger establishment. ...
>
> It is proposed to fill up the establishment of the survey of Central Cuttack immediately from assistants to be found if possible in Calcutta, leaving the subordinates to be sent down from Allahābād to be posted to the other surveys as they arrive. The Assistants for the Central Survey will be hired at once in Calcutta and, obtaining tents by indent from the arsenal,

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[1] from Rev. Bd. WP., 26-7-33 ; BTC., 2-9-33 (12). [2] from Siddons, 20-10-34 ; BTC., 10-11-34 (37). [3] for contingent expenses [346, 364]. [4] from Rev. Bd LP., 31-7-38 ; BTC., 22-8-37 (1). [5] from DSG., 17-6-40.

> will be sent down to Cuttack with all possible dispatch, so as to admit of the Survey being commenced by the 15th November. ...
>
> It is further proposed that the officers and establishments of the other surveys should join this one, by which...they will acquire practical experience much quicker than if they were at once to commence the survey of their own zillahs, the inevitable result of which would be blunders innumerable. ...
>
> Although Assistants at Rs. 250 are entered in this list, it is not proposed at first to give a higher salary than Rs. 150, thus keeping open the higher grades to the most meritorious[1].

Allahābād was asked to help with experienced assistants, and to lend the services of the Deputy Surveyor General to start the new surveys on the right lines. Bedford put in his first report early in April 1838, on which the Board of Revenue noted

> the great expense of the survey establishments in proportion to the work performed. This... he ascribes to the insufficient number of ameens and khalasees employed. ... He proposes that to each survey should be allowed a fixed monthly sum, ... and that the Surveyor should be authorized to employ khalasees and native surveyors within that limit, ... as the state of the work may require. Contract work...will be included within the fixed amount. This system, ... has had the test of experience in the North West Provinces [347].

4 Office Assistants	Rs.	600
Native establishment, exclusive of khasrah measurements		735
Native establishment, including khasrah measurements		1,105

> The plan...of maintaining on half pay during the rains such of the khalasees as may prove to be useful...must involve a considerable increase of expence, but has been found...to answer in the North Western Provinces[2].

RECESS QUARTERS

During 1831 when Everest was searching for suitable officers for the Great Trigonometrical Survey, and was most anxious to offer them the very best terms of service, he wished to counter a retrenchment made by the Accounts Departments, which restricted to Rs. 250 a month the salary of survey officers during three months of the rains, under regulations laid down in 1785 [I : 277]. He claimed that this restriction could not apply to his officers [352-3];

> The work of the Great Trigonometrical Survey of India never has been confined to particular months of the year. The system of reducing the salaries of a field surveyor was founded on the principle that a gentleman...was...to maintain a certain establishment of classies...whilst in the field, who could be hired when wanted, and discharged when the work was suspended. ...
>
> But the operations of the Great Trigonometrical Survey...have been carried on more during the rainy season than at any time of the year, and under the late Lieutenant Colonel Lambton... it was usual to select those very three months as the fittest for field labours, on account of the clearness of the atmosphere [III, 8]. ... The rainy season is often quite as healthy as any other, and parties are employed in such cases all the year round indifferently. For a mountainous country covered with forests the months of October, November, and December are frequently much more objectionable than either July, August, or September. ...
>
> Since gentlemen so liable to be called upon have no power to make any reduction in their establishments, I...submit...that the salary...granted to gentlemen on the Great Trigonometrical Survey of India be continued throughout the year as a staff salary[3].

This was accepted, and even though it later became the regular practice for parties of the Great Trigonometrical Survey to go into recess quarters for a few months during the rains, yet the officers continued to draw full survey allowance throughout the year, whereas other surveyors were required to drop to the reduced salary for three months of the rains [364]. In the case of revenue surveyors, to provide for varied conditions of season and climate, it was ruled that they should draw a flat rate of Rs. 526 a month throughout the year [III, 349-50, IV, 365]. The rigid prescription of three definite months for withdrawal to recess quarters was eventually abandoned. The recess season was generally spent at district headquarters for revenue surveyors—at the most convenient central station for the G.T.S.

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[1] from Fraser, Cuttack, 25-9-37 ; BRC., 12-8-38 (85). [2] from Rev. Bd. LP. 24-4-38 & 1-5-38 ; BRC., 19-6-38 (15) ; 16-10-38 (3). [3] DDn. 265 (245-7), 19-9-31.

After 1840 the Bengal revenue parties usually went into recess

> from 1st of June to the middle of November, the rains generally driving the survey parties into the station about the former date, whilst the state of the country prevents an earlier assumption of field duties than the latter named period, or even the 1st of December.
>
> In the N.W.P. little can be done in the field in May, while the recess terminates as early as the 15th October, by which time the country...is very favourable for active operations[1].

Early in 1832 Simmonds, of the Delhi survey, asked permission under medical advice to carry on his duties at Simla instead of Gurgaon during the hot weather and rains [218]; his draughtsmen would be left in Delhi under his senior assistant. This was refused but he was told he could "apply in the usual form for leave of absence". This he appears to have done, for he was allowed a temporary assistant at Simla "on the salary of the native writer recently discharged...at Delhi"[2] [218].

Accommodation at district headquarters for the rains was often difficult to find and in 1833 Simmonds asked for an extra guard for his instruments and stores, as his office would be accommodated in tents. Bedford referred this to Government;

> I do not myself consider this measure as either authorized or eligible. Not only must the tents be seriously injured by such exposure, but instruments also be liable to injury during storms. ... As Captn. Simmonds...not only avows his intention of having the public tents pitched during the rains, but founds thereon the insufficiency of a naick and four sepoys to protect the...property, ... serious loss...must attend the proposed arrangement.

To meet the situation he recommended an allowance for office rent of Rs. 30 a month, as a building would be far more suitable than a tent[3]. Government agreed;

> Captain Simmonds' intention to keep the government tents pitched for...depositing the government property during the rains...evinces how little he considers the interests of Government. He proposes to leave the instruments and public property exposed in a tent, in which they are liable to be destroyed, and he unnecessarily exposes the tent during the rains, and for all this objectionable arrangement he requires an additional guard.
>
> You will admonish Captn. Simmonds. ... It is presumed that he has no intention of exposing himself or his private property in a tent during that season, and it is not creditable to him that he should be less careful of the Government property[4].

In June 1843 Sherwill (184) asked permission to use the circuit house at Gaya for his party office which had

> left the field, ... and is now at Gya, but...without any covering beyond that afforded by tents. I would again[5]...bring to the notice of the Sudder Board the extreme jeopardy in which all the valuable map work...is placed by my not being able to procure any shelter for them, ... no sort of building being procurable wherein I could house my draftsmen, &c.
>
> Immediately the rains set in, work will be much retarded, if not entirely stopped, as, during every heavy fall of rain all maps and papers must be secured or ruined. If Government would sanction the circuit bungalow being used as an office, all these difficulties would disappear.

This appeal was endorsed by Stephen who pressed for

> even two rooms of the Circuit Bungalow as an office. No persons with the exception of a guard would be permitted to reside in the compound, and every caution would be taken to preserve the rooms in the same cleanly state they are in at present and, should the Government be pleased to...affix a rent, I shall be happy to pay[6].

The application was refused as contrary "to existing rules", rules that were still sternly enforced one hundred years later.

NOMINAL ROLLS : CLERKS

Names	Birth & Death	Appointed	Employment	Domestic, etc.
BARNES, Geo. ...	b. c Dec. 1799	1836	1835–6 wr., C-in-C.'s Office; 1836, 3rd wr. SGO., Calcutta; 1854, 2nd wr.; ret. on pension, 1855.	m.
BERRILL, Robt.	..	1834 ?	resd. Oct. 1838, after 4 y., in SGO. DDn.; 1842, Govt. Steamer Agent, Allbd.	
BOTELLO, Alex.	..	1823	1823–6, hd. wr. to RSG. Ftgr.; 1826–32, hd. wr. to RSG. & DSG., Calcutta; 1832–7, with DSG. Allbd.; dism. Aug. 1837.	1843, Chapel Minister Calcutta.

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[1] Thuillier & Smyth (515). [2] BTC. 4–9–32 (45). [3] from DSG. 23–4–33; BTC. 13–5–33 (56¼). [4] BTC. 13–5–33 (57). [5] earlier appn. dated 9th May had been refused. [6] from Sherwill, 1–6–43; from Stephen, 9–6–43; BRC. 31–7–43 (37).

Names	Birth & Death	Appointed	Employment	Domestic, etc.
BOTELLO, James	...	1838 ?	1838–43(?) 2nd wr. to DSG., Calcutta ; 1855, hd. cl. Bhangy Dept. GPO.	
CAZABON, J. W.	...	1834	1834–9, asst. wr. to DSG., Allbd.	
DIAS, A. [1] ...	...	1830 ?	1830–1, asst. wr. SGO., disch., 19–1–31.	
DIAS, Joseph ...	...	1818 ?	hd. wr. SGO. Calcutta ; 1832–4 ; to Mussoorie & Dehra, disch., 8–5–34, after 16 y. service ; 1843, Collr's. cl., Meerut.	violinist ; bro. to Peter [*inf.*] ; m.
DIAS, Peter ...	...	1828 ?	1828–34, asst. wr. to DSG., Calcutta & Allbd. ; resd. 1834.	
HARRIS, Joseph M.	b. 1806/7, Lambeth, Surrey.	1838	enl. Art. 1825 ; 1826, arrd. India ; 1838–41, actg. Regr. SGO., DDn. ; 1–11–41, to pension est.	Sgt. Ben. H. Art., Meerut.
HELY, Francis	...	1838	1838–43, hd. wr. to DSG., from Preventive Service, Customs.	
HOLLINGBERRY, E. W.	...	1842 ?	1842, 4th wr. SGO. ; resd. 10–12–42.	
MORRISON, Chas. [III, 314]	...	1830	1830–38 ; Regr. to SG., Calcutta, Mussoorie, Dehra ; 1838–41, to England ; resd., 1841.	m. before 1832.
OLLIVER, Andrew Cornelius	b. Hdbd., 24/30–4–22 ; d. DDn., 24–8–56.	27–8–39, Mussoorie	1837–9, wr. with Rev. Bd. ; 1839–42 ; SAS. GTS. ; hd. wr. SGO., 11–10–1844 to DO. DDn. 29–4–53 till death.	Son of Joseph [III, 491] ; m., Landour, 18–8–43, Emilia Billon ; she d. before 1854.
ROBERTS ...	...	1837	1837–9, hd. wr. Rev. Svys., Allbd.	from Gorakhpur.
ROSS, A. B. ...	...	1832	1832–5, asst. wr. with SG., Calcutta, Mussoorie, Dehra.	Asst. Comnr. Nāgpur, 1858.
SCOTT, Geo. Hamilton	b. *c.* Oct. 1815 ; d. DDn. 14–7–43.	1835	1835–40, wr. SGO., DDn. till death.	Son of Wm. Scott [III, 501] and bro. to Wm. Henry [*inf*]
STAPLETON, Chas. Thos.	b. Nov. 1819, d. 12–10–61, Calcutta.	1833	1833–7, wr. SGO. Calcutta ; later, dmn. QMG.'s Office.	
TAYLOR, Thos.	...	1831 ?	1833–5, wr. SGO., Calcutta.	
WEBB, Geo. Parker	b. July, 1816	July 1834	1834–41, hd. wr. SGO. Fd., DDn. ; 1841–64, Regr. ; resd. 1864.	unm., 1860 ; son of Maj. Nath. Webb. Ben. Art. who d. 1833.

DRAUGHTSMEN

Names	Birth & Death	Appointed	Employment	Domestic, etc.
BLACK, J. ...	...	1835 ?	1835–9, DO., Calcutta.	
CHILL, David Henry [III, 371]	...	1832	1821–31, Rev Svy. [387] 1832–5, DO., Calcutta ; resd., 1835.	
CHILL, H. R. ...	...	1833–4,	DO., Calcutta ; resd., 10–11–34.	
CORNELIUS, John [III, 370]	b. 1802/3, d. 15–5–79, aged 80 y., MI. DDn.	1831	1820–2, QMG.'s Dept., Madras ; 1823–31, Nagpur Svy. ; 1831–2, DO., Calcutta ; 1833–52, SG.'s Fd. DO., DDn. ; ret. on pension Nov. 1852.	m., 1st DDn., 5–3–40, Charlotte Watson, wid. ; m., 2nd. Julia Matilda who d., DDn., 16–3–1930, aged 73 ; father of W. J. Cornelius, appd. Topo. Svy., 1866 ; Markham (445).
DIAS, Michæl H.	d. Calcutta, 23–6–45, aged 29.	1832 ?	1832–8, DO., Calcutta, resd. 15–3–38.	
GORE, S. J. ...	...	1837 ?	1837–9, DO., Calcutta ; resd., March 1839, for Salt Dept.	m., Calcutta, 29–11–37, Miss Caroline Dias.
GRAHAM, John [III, 371].	...	Hd. Dmn. 1829–58.	*v.* Biographical Notes.	
GRAHAM, Walter Rose Malcolm	b. *ct.* 19–12–20 d., Calcutta, 15–11–60.	1842 ?	1842, Rev. Svy. DO., Calcutta ; till death.	son of John Graham (*inf*). m., Calcutta, 9–8–42, Miss Emma Ridge.
HUDSON, Christopher K. [III, 314]	...	1828	1828–32, DO., Calcutta ; Nov. 1832, to Rev. Svy. Assam ; 1838, Asst. Comnr., Assam.	
JOSEPH, Chas. [III, 321 n.3]	b. *c.* 1–8–02 ; d., Serampore 4–6–59.	1823	1822–23, SGO., Madras ; 1835–43, DO., Calcutta ; 1845, PWD., Benares Rd. ; 1854, Rev. Survr., Sundarbans.	m., before 1838.
MACREDDIE, Geo. King	b. 20–2–05	1821 ?	1821–45(?) DO., Calcutta.	sometimes McReady [III, 314].
MACVICARS, Wm.	b., Madras, 22–6–05.	1831	1820–8, with SE., Madras ; 1829–31, with QMG., Madras ; 1831–3, DO. Madras ; 1835–46, DO., Calcutta.	
MOFFATT, C. H.	...	1832	1832–4, DO., Calcutta ; 1834 resd., for post on Rs. 125.	
NEIL, P. H. ...	...	1834	1834–6, DO., Calcutta ; resd., 1–7–36.	
POTENGER, Geo.	b. June 1820 (or July 1823?)	1837	1837–41, DO., Calcutta ; 1841–5, Purser, HC. Ship *Proserpine* ; 1846–60 DO., Calcutta.	m., Calcutta, 15–5–46, Sarah dau. of W. D. Smith.
POTTER, Edw. Michæl	bapt., 11–5–20	1834	1834–5, DO., Calcutta ; 1840, in office of AS. Police, Calcutta.	son of Samuel & Margaret Potter ; m., Calcutta, 25–5–40, Juliana Harvey, dau. of A. H. D'Mello.
SCOTT, Wm. Henry [III, 314 n.2]	b. Sept., 1812, d., DDn., 10–2–73.	1827	1827–32, DO., Calcutta ; 1833 Hd. Dmn., DDn. till death.	son of Wm. Scott [III, 501] m., Landour, 30-9-43, Miss C. E. Shorts, aged 14.
STAPLETON, Geo. H.	...	1833	1832, Lith. Printer, Calcutta ; 1833–5, DO., Calcutta ; 1835–55, Govt. Litho. Press ; 1855, SGO., Printing Sec.	m., before 1847 Clarintine Eleanor.
WILSON, Edw.	...	1832 ?	1832–5, DO., Calcutta ; resd., 1835.	

INDIAN DRAUGHTSMEN

Abdul Halim (1855)
Abdul Khadar (1860)
Ain-ud-din (1844)
Ghulam Nakl (1860).
Khadam Ali
Khadam Husain (1844)
Jai Narain Biswas
Manir-ud-din (1856).
Nasrat Hussain (1844)
Mian Jan (1844)
Piari Lal
Shaikh Din Muhammad.

Of these, Piari Lal was entertained by Mackenzie in 1818 ; accd., Hodgson to Fatehgarh 1823 ; returned to Calcutta 1826 ; joined Bedford, Allahābād, 1833 ; to Lawrence in Farukhābād, 1834 ; with Rev. Svy. Hdqrs., Allahābād, till 1830.

Dates indicate lists in which names still appear.

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[1] Bartholemew Dias, Portuguese, rounded Cape of Good Hope 1487/8.

CHAPTER XXI

MILITARY SURVEYORS

GREAT TRIGONOMETRICAL SURVEY ; *Bengal* — *Bombay* — TOPOGRAPHICAL SURVEYS ; *Bengal* — *Madras* — REVENUE SURVEYS ; *North-Western Provinces* — *Bombay* — NOMINAL ROLLS ; *G.T.S.* — *Madras* — *Bombay*.

EVEREST returned to India in 1830 with orders to press on the Great Trigonometrical Survey [2, 9]. The Madras and Hyderābād Surveys were to proceed, as also the revenue surveys. No other surveys were to be carried out 'except in unexplored countries, when information is wanted for military purposes'[1].

Able officers with mathematical knowledge would be required to extend the trigonometrical survey on the wider scale now planned. From 1812 Lambton had no officer of any education till Everest joined him in 1818, and after his death Everest had worked for two years with only two experienced assistants, Olliver and Rossenrode[2]. These two were now the only trained assistants available, though under the new conditions they were not fit for independent charges [15, 370].

Everest obtained sanction for six separate field parties, one to be under his own direct charge [14][3]. He wanted five officers capable of independent charge as soon as possible, and others to be ready to replace casualties. Apart from officers on the Madras topographical, and the Bengal revenue, surveys, there were three comparatively senior Deputy Surveyors General at the three presidencies ; there was Robert Shortrede in charge of Bombay triangulation, and Wilcox, Ommanney, and Boileau on topographical surveys in Bengal[4].

He first tried to secure the services of two newly arrived Engineer officers whom he had met in England,

> H. M. Durand, ... James Western. ... In March 1828, the Honorable Court of Directors expressed a desire that all the young gentlemen destined for their service, then under Colonel Paisley's tuition at Chatham[5], should be sent to Greenwich for a fortnight in order that the nature and use of the pendulums of experiment, and other scientific instruments with which the Royal Observatory abounds, might be fully explained to them by me, and that I might have...personal knowledge of their various talents and dispositions.
>
> Of the whole party, the above-mentioned...alone showed any disposition to profit by the opportunity, ...and in both...I had occasion to remark decided indication of mathematical genius. But of Mr. Western I must speak in yet more unqualified terms, for his attention at the observatory was quite unremitted. ...
>
> When in the month of March last...I undertook an experimental measurement with the compensation bars in Lord's cricket ground [45], Mr. Western, who had just then left Chatham, came of his own accord to offer his services. He...took charge of one of the microscopes and rendered himself exceedingly useful, ... whereby he has acquired...a considerable practical knowledge of...this complicated apparatus. ...
>
> I have since had an opportunity of seeing much more of Mr. Western, as he was my fellow-passenger on board the Cornwall, and...the favorable impression...has been confirmed by a more intimate knowledge of his character.
>
> The expediency of instructing...young men who have a natural mathematical bias, while the early impressions of their education are still recent, will...be sufficiently obvious, but...the youths at Addiscombe are taught nothing but what is purely elementary, and...there is so much which can be learned by practice alone that the novice...with a party of the Great Trigonometrical Survey would find himself very much at a loss. ...

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[1] SG. to Mil. Dept., 21-6-32 ; BMC. 3-9-32 (137). [2] excluding the juniors, Torrick and Peyton. [3] BMC. 27-2-32 and SG. to Mil. Dept. 19-9-38 ; DDn. 342 (227-31). [4] lack of trained staff, *Meridional Arc* (x). [5] General Sir Chas. Wm. Pasley (1780-1861) ; *DNB*.

I...suggest that the salary...of these gentlemen be that of an assistant surveyor in the Revenue Department, viz., 250 Rs. per month [365]. If that be granted, I shall take an early opportunity of employing each of them in the field, accompanied by one of the young men who were trained up under the late Lieut. Col. Lambton and myself[1].

As Durand was not available, Henry Rigby joined with Western in March 1831 for instruction under Joseph Olliver, whose triangles were nearing Calcutta [2, 58] ;

My object in thus detaching you being to make you practically acquainted with the duties of the profession, ... you cannot have a better opportunity than that now offered you, for Mr. Olliver is a person of great experience and practical talent.

From the difference of your circumstances it is impossible that I can place you under his authority as I should do if he were your senior in rank, but it is...equally impossible that I can make him subordinate to any other than myself. ... You should consult his wishes and defer to his judgement, for...the task of instructing is one of the most irksome that can be imposed on a person of retiring habits. ... You, not he, are to derive benefit from it[2].

To Olliver he writes ;

Mr. Western and Mr. Rigby left this on the 20th instant to join you. ... Give them all the practical instruction you can, taking care that you entrust no duty to them which can at all effect the accuracy of the work without your supervision, until you are persuaded...that they are sufficiently experienced to dispense with such supervision[3].

He rebuked Western sharply a few weeks later for coming in from the field without formal permission ;

When an officer is detached on any duty it is not competent to him to quit without the sanction of his superior. You have neither asked, nor received, my permission to return to Calcutta, and you do not mention whether you have consulted with Mr. Olliver, ... although the common delicacy could have entitled him to so much consideration from you.

The reasons you have assigned are not sufficient. ... Distance from Calcutta is not a reason for returning there. Approaching rainy season is no reason for your not remaining in the field whilst operations can be conveniently carried on.

Lastly, ... there is no precedent for the Trigonometrical Survey having any concern with quarters. That establishment is considered always in the field, and though during certain seasons in the year, when operations cannot be carried on, it is usual to seek shelter wherever it can be found, yet it is not usual to notify that in a public correspondence [348].

I therefore recommend you to...recall your letter of the 26th May, for if it remains amongst the official documents...you will...be considered by the Military Auditor General as precluded from the privilege which all other parts of the establishment have hitherto enjoyed[4].

The privilege referred to was exemption from reduction of allowances for three months of the rains [I : 277 ; II, 326 ; III, 346]. Everest was ready however, to nurse young men new to the country, and whilst arranging for Olliver to bring his party in for computations [370] he asked authority to call in the young officers ; " The chairman of the Honorable Court of Directors...desired me to be careful of not exposing the lives of the gentlemen from Addiscombe unnecessarily "[5].

Two months later Rigby left on account of dysentery, and his place was filled by Percival Bridgman, of Artillery, also educated at Addiscombe.

For the last six months he has been pursuing his studies with my assistants at such intervals as his military duties allowed him, and...he is equal, if not superior, in point of abstract mathematics to the greater part of these gentlemen who come out for the Engineers[7].

To complete his team for the measurement of the Calcutta base-line [48–9], Everest brought in Wilcox from the Brahmaputra survey [265] ;

Eight persons...are required. Of this number the four sub-assistants of the Great Trigonometrical Survey [50]—the Astronomer...at Madras [115]—Lieut. Western of the Engineers—and Mr. Logan, a young gentleman whom I appointed as locum-tenens for Mr. Rees in...March last [379–80]—are available, and...an eighth person is requisite. ...

Lieut. Wilcox being one of the ablest gentlemen employed in the department, ... it is advantageous to select him in order that he may acquire under my own eye a thorough acquaintance with the practical use of the apparatus[7].

Any man of science, however familiar...with the use of instruments, would on seeing the new base-line apparatus in its disjointed state pronounce that to use it with facility would be

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[1] to Mil. Dept. 19-10-30 ; DDn. 265 (65-8). [2] SG. to Western, 15-3-31 ; DDn. 267 (59-61). [3] ib. (61-2), 22-3-31. [4] ib. (68-9), 30-5-31. [5] DDn. 265 (207), 13-6-31. [6] ib. (235) ; from SG. 18-8-31. [7] ib. (243-4), 19-9-31.

> impossible. Yet Captain Wilcox in a very few days became perfectly master of its application, and to the aid I have derived from him and Mr. Taylor I principally owe that...the whole of the laborious operation has been concluded in less than two months[1].

From the revenue surveyors, Everest recommended Macdonald and Fraser only. Though several of them were skilled

> in the more detail work of the Revenue Department, ...it is Captain Herbert's opinion, as well as mine, that so far from the practical knowledge they have acquired qualifying them for extensive trigonometrical operations, it would stand in their way and need to be unlearned before they could start in their new career. Gentlemen do not like to unlearn what they have acquired ; it is generally a harder task to do so than to begin afresh.
>
> It is my decided persuasion that Lieut. Wilcox is...highly able, and likely to qualify himself in a shorter time than any person in the Department. ... I have long watched...the admirable manner in which he has carried on his detail survey of the Burrampooter by throwing a series of small triangles across that river. ... There is a style of accuracy and neatness about his operations which I have never seen surpassed. ... This gentleman's knowledge, instead of requiring to be unlearned, will all turn to account on the meridional series. ...
>
> Lieut. Boileau, of the Engineers, seems...to be a gentleman of zeal and ability, but I have seen scarcely anything of his since my arrival excepting perambulator work, which I should class under the head of knowledge to be unlearned. ... He is fitted for higher work than this. ...
>
> Lieut. Western...is as yet very young, but when he comes to be matured by a few years experience...he will be a great acquisition to the Department. ...
>
> Lieut. Bridgman, ...a person of talent, assiduity, and of mathematical attainment, ... is young, and requires a few years experience before he can be useful[2].
>
> Lieut. Macdonald was educated at the Royal Military College of Sandhurst, where he obtained the first prize. ... He was...offered a commission in the Royal Staff Corps [II, 445 n.6], which he thought proper to decline. ...
>
> The mathematical acquirements of this gentlemen are highly respectable, and from what I personally know of the system of education at Sandhurst, the habits of subordination which are inculcated, the style of the élèves, and the rigorous examination...previously to obtaining commission, I should much prefer...those who have been trained in such a school to the young men who have been merely subjected to the desultory course of elementary study at the Hon'ble East India Company's seminary at Addiscombe[3].

Government approved all these recommendations, and promised the services of "any other qualified Engineer Officer on whom your selection may fall[4]". For domestic reasons Fraser preferred to remain with the revenue survey, but Andrew Waugh and Thomas Renny, both of Engineers, were posted during July 1832. By oversight these officers were designated "Sub-Assistants" in their posting orders, and on Everest's protest this was changed to "Assistants, 2nd Class, Great Trigonometrical Survey", on salary Rs. 250, with prospect of promotion to 1st Class on Rs. 618[5] [I : 277 ; II, 326 ; IV, 365].

Everest insisted that "advancement...to the 1st grade of Assistants" should depend solely "on the recommendation of the Surveyor General and Superintendent of the G.T. Survey", and that any refusal to accept his recommendation would have "the very worst effects on the subordination of this Department"[6] [354, 357]. He obtained an official ruling that his officers should draw full allowances throughout the year ;

> The duties of surveyors...are unequal, being at times of excessive hardship and fatigue, and at others not more arduous than...the ordinary routine of the service. ... Officers who conduct certain surveys are exempted from the regulation which reduces the allowances for the months of July, August, and September, and this exemption has always hitherto been an indulgence extended to the Great Trigonometrical Survey of India [348, 352][7].

Wilcox and Boileau were already drawing the full Surveyor's allowance, Rs. 618, and Wilcox was now appointed to a special post as Astronomical Assistant, being

> competent to undertake the celestial observations connected with the Great Arc. ... I cannot better forward the object in view [than] by recommending Captain Wilcox for that situation, on a salary of 600 rupees per mensem. ... Though the main duties...will be astronomical, yet his services will at all times be available for...the Great Trigonometrical Survey, and...he will be more useful than a mere astronomer could ever be[8] [131].

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[1] DDn. 283 (18–22), 25–1–32. [2] to Mil. Dept., 12–10–31 , DDn. 265 (261–91). [3] ib. (218–9) ; from SG. 1–7–31. [4] BMC. 27–2–32 ; GO. 12–3–32. [5] GO VP. 16–7–32 ; DDn. 325 (39). [6] DDn. 452 (38–9), 3–8–43. [7] DDn. 265 (235), 23–7–31 ; from Mil. Dept., 28–10–31 ; DDn. 263 (339). [8] DDn. 283 (87–8), 15–6–32.

Wilcox successfully appealed for the allowance to be raised to the standard rate ;

> Government has lately decided that the salaries of all the officers attached to the Great Trigonometrical Survey shall be paid in sonat rupees. I beg...the Honorable the Vice-President in Council...to restore my former salary of 618 sonat Rs., which...I should have continued to draw, had not a specific sum (600) been named, and which, since the Trigonometrical Survey allows of no respite...during the rainy season, I should...draw throughout the year.
>
> It was, I believe, your intention that I should be allowed the same salary (i.e., 600 sicca rupees) which you drew when assistant to Colonel Lambton[1] [III, 352].

The tiresome distinction between *sicca*, or newly minted rupees, and *sonat*, or those which had been in circulation two years or longer, was abolished in 1835 by the introduction of the "Company's Rupees", which was thereafter current throughout the three presidencies [I : 274, n.3 ; IV, 329 n.6].

Boileau was deputed early in 1832 to reconnoitre for an approximate series of triangles between Sironj and Agra [23]. He was particularly directed not to be deterred by the rainy season, unless your people get unhealthy. In that case you must seek shelter, but I have been told that the part of the country between Sironj and Agra is more healthy in June, July, and August than at any time of the year, and it is not unusual for parties engaged in final operations to brave the rainy season, whilst for approximate work that season is preferred on account of the clearness of the atmosphere [III, 232][2].

It is just possible that this letter had not reached Boileau, but on 19th June, after less than two months work during which he had not fixed a single station, he decided that the weather was too hazy and unfavourable, and reported that he was marching back to Agra, 180 miles away. Everest was deeply disgusted ;

> I sent you a copy of the letter which induced Government to accede to my request of exempting your salary from reduction [352]. It is...unprecedented in the prosecution of an approximate series to leave the field on account of dusty, windy, or rainy weather. ...
>
> Mr. Rossenrode conducted an approximate series in high style from the Nerbuddah to Seronj through a very wild...country in...July and August 1824 ; the distance is upwards of 90 miles [III, 245]. I have myself been out in all weather, and never yet flinched from exposure. ... The operations on the Great Arc are liable to be thrown back a whole year[3].

Boileau was safely back in Agra by the time this reached him, and Everest reported leniently that he would not

> attribute much blame to Lieut. Boileau for, in the first place, his experience has...been confined to wheel and compass surveying, ... a totally different thing from trigonometrical operations. All professions...require some sort of previous tuition, and mere theoretical instruction would not more enable a person to succeed in a work of this kind than...school study of navigation would enable him to pilot a vessel through a tempestuous sea.
>
> If Lieut. Boileau had been a man of commanding genius he might have succeeded. ... For instance, the late Colonel Lambton, I am persuaded, would never have quitted the field until the work was accomplished, for to return without would have broken his heart [III, 468]. ... There was a possibility that Lieut. Boileau might be one of that stamp, and on the chance of this I recommended that he should be entrusted with...the work[4].

In spite of his disappointment, Everest assured the Auditor General that Boileau was entitled to his full allowances throughout the rains.

In February 1832 Western left Calcutta in charge of the Parasnāth Series [59]. Macdonald followed in November to start the Budhon series from the neighbourhood of Saugor [61] ; he would

> in the first instance receive no increase of salary[5], but whenever his progress is such as to warrant my so doing, I shall take liberty of recommending...the full salary, ... and I...recommend as a most salutory rule for all the...assistants, that any one of them who is capable of conducting a meridional series satisfactorily, may be placed on the full salary without reference to his rank or standing in the Department[6] [353].

At the same time Waugh and Renny left to join Rossenrode's party on the approximate series where Boileau had failed [24]. After a few months with this experienced surveyor—"they cannot be expected to conduct duties of this sort intuitively"—they reached Agra to raise field parties for the Ranghir and Amua series [64, 67].

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[1] DDn. 284 (181), 23-10-32. [2] DDn. 267 (125-8), 1-5-32. [3] ib. (137-8), 12-7-32. [4] DDn. 283 (121-3), 9-8-32. [5] Rs. 250 pm. as Asst. Rev. Survr. [III, 350]. [6] DDn. 283 (175-6), 13-10-32.

Bridgman was posted as assistant to Macdonald on the Budhon series, but owing to ill-health did not join until February 1834. After further interruption from sickness and only a few weeks in the field, he was transferred to the Parasnāth series to relieve Western who had proved a failure [59–60]. Bridgman's health now broke down completely, and he died at sea in April 1835.

After assisting Everest on the reconnaissance of the Great Arc during the cold weather of 1833–4—this time keeping the field right through till August—Boileau joined the Shekhāwati expedition in September and spent a year on survey in Rājputāna [271–3]. He then took charge of the Parasnāth series until December 1838, when he left the department for more congenial work. Like Western he was not a great success, and the quality of work on the Parasnāth series was poor.

> From Lt. Western's first essay I was...in great hopes of his success, but he soon began to waste his time in quarrelling with the sub-assistants, ... which ended in the dismissal of Mr. M. Torrick and Mr. [E. R.] Boileau [372]. But this did not advance the operations, and a want of attention to the systematic rules...seems...to have prevailed in the Parasnath series, which it had been utterly out of my power to rectify, on account of the difficulty of procuring an officer possessing the requisite elementary scientific knowledge of a geodesist, ... content to adhere closely to the path prescribed. ...
>
> A reasonable hope might have been entertained that an officer of Lt. ...Boileau's celebrity would...correct these defects, but that gentleman's abilities, though of a first rate order in route surveying and...reconnaissance, were...not suited to that close attention to the minutiæ of accuracy which such a work demanded.
>
> He had abundance of energy, zeal, and activity, and, perhaps, in knowledge of the native language and conciliatory deportment towards the inhabitants has few equals in India. These are important qualities, but they do not make up for want of system, and...about the whole... Parasnath series from first to last there has been a slovenliness of style, totally out of keeping with the other parts of the Great Trigonometrical Survey, and by no means tending to enhance its respectability [60–1][1].

Early in 1835, after the Brahmaputra survey had been closed down [265–7], Ommanney was posted to the Budhon series, and on Macdonald's resignation in September took over charge, only to resign in his turn in May 1837. As in the case of Western, the reason for Ommanney's departure was not ill-health, but a definite lack of survey talent, though both of them, with Boileau also, distinguished themselves later as engineer officers. In 1837 Everest reported that

> in March 1835 Lt. Ommanney joined my headquarters in the Dehra Dun. The base-line had then just been completed, but the instruments were all in the field and in active use, and Lt. Ommanney had the most favourable opportunity...of...acquiring a further acquaintance with them. ... Lieutenant Ommanney did not shew the slightest knowledge of the management or construction of the instruments. ... He displayed no...inclination to remedy this defect, so that, though he remained at my headquarters until 18th May 1835, when he was sent to join Lieutenant Macdonald, he did not at his departure know more than on his arrival. ...
>
> I found him uninformed in mathematical subjects to an extent hardly to be credited. Even on elementary questions in Trigonometry and Algebra his knowledge was utterly defective, and...I perceived no symptoms of his being alive to the necessity of remedying it.
>
> The Budhon series was commenced...in February 1833, full a twelve-month before those of Ranghir and Amua [61–4], and though Lieutenant Ommanney actually had the conduct of the work for full 18 months...yet it had not sensibly progressed. The work to which he so proudly refers...consists in the measurement of angles...at 5 principal stations, ... selected by Lieutenant Macdonald before his departure. ... But...why was so long a time...[spent on] so small a task, which ought not to have occupied...5 weeks at the utmost ? It is my persuasion...that Lt. Ommanney did not know how to use the 16-inch theodolite[2].

A very promising recruit, William Jones, of Engineers, joined in June 1835. After two seasons on the Great Arc, Everest reported that he had been

> exceedingly useful, and continues to shew an abundance of zeal and skill. I have taken considerable pains to train this gentleman to...his profession. ... He has had advantages and opportunities which fall to the lot of few, and he has turned them to a right account[3].

Unfortunately Jones had to resign on account of ill-health. He was given charge of the Karara series from January 1838 but, writes Everest later,

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[1] DDn. 344 (195–254), 21–8–39. [2] DDn. 342 (7–9), 12–4–37. [3] DDn. 324 (4), 8–1–37.

> in the latter end of that year the party...was attacked by sickness, and he has done no duty since. ... He is a gentleman of considerable natural talent, and a very good observer, and if he could...devote himself to this line...he would be an acquisition to the G.T. Survey, but... neither the...duties, nor the kind of life, are to his taste[1].

Wilcox spent 1833 and 1834 assisting Everest on the reconnaissance of the Great Arc [27-38], but in January 1835 he left the survey to take up the post of Astronomer to the King of Oudh, that had been vacant since Herbert's death [115]. In recommending Waugh to succeed as Astronomical Assistant, Everest urged an increase of allowance ;

> That situation, although requiring more talent than any other subordinate to me, has nevertheless no additional remuneration, ... and as the number of those...qualified to hold it is very limited...I am perpetually liable to be deserted in the time of my need, on account of the temptation held out in other quarters.
>
> The salary of Astronomer to His Majesty of Oudh has in this wise induced Captain Wilcox to quit the Great Trigonometrical Survey, which...he would never have done but for a temptation which no married man could prudently resist. ... Far from condemning him, ... I should have recommended the selection of Captain Wilcox and counselled him to offer himself as a candidate, much as it is contrary to my wishes to part with a person whom I prize so highly.
>
> I recommend Lieutenant Waugh as a successor to Capt. Wilcox, with a personal salary of 1,000 sonat rupees, besides the pay and allowances of his military rank[2].

Government not only refused this increased salary but, as in Wilcox's case, actually sanctioned the allowance as 600 *sonat* rupees only. It was not until June 1837 that Everest was able to challenge this reduction ;

> On the 5th Feb. 1835 my Lord Wm. Bentinck transferred Captain Wilcox, who was then my Astronomical Assistant, to the charge of the observatory at Lucknow, and desired me to select a suitable person to be his successor. ... I specified Lieutenant Waugh. ...
>
> Captain Wilcox...had received a salary of 618 sa. Rs. per month, ... and as that did not suffice to retain him with my Department in the face of more advantageous offers, I ventured... to suggest that his successor should be placed on such salary as would put him out of the reach of similar temptation.
>
> Your letter...dated 27th April specifies the salary of Lieut. Waugh to be 600 Rs. per month as Astronomical Assistant and, as that officer had...been in the constant receipt of Rs. 618 per month, I should...suppose that the former salary was intended to be superadded to the latter, but...the general tenour of your letter was that of dissent from my proposition. ...
>
> Lieutenant Waugh...continued to do his duty in the same spirit of earnestness, good will, and unobtrusiveness, as if nothing uncommon had occurred, so that it was only...in January 1836...that it came to my knowledge that the Military Auditor General had given the very interpretation...which my delicacy had made me forbear to do, and had actually insisted... on reducing Lt. Waugh's salary from 618 to 600 per month.

After recounting Waugh's valuable services he recommended that his

> salary of 600 Rs. per month as Astronomical Assistant commence from...his joining the Great Arc camp at Saini on the 3rd January 1836. ... That from the same date he [should] receive, besides his salary as Astronomical Assistant, one half of the salary assigned to him...as conducting the Ranghir series, together with the military pay and allowances of his rank[3].

Government replied that although there had been no mistake about their refusal to increase the salary to Rs. 1,000, it had not been their intention to reduce it, and that it should stand as Rs. 618.

As part of his functions as Astronomical Assistant, Waugh was to supervise the computations of all field parties that recessed at Dehra Dūn, report progress to the Surveyor General, and act as channel for all orders and applications to and from the units working under him[4].

Everest again became anxious about his supply of officers. He was left in 1837 with Waugh, Renny, Jones, Boileau, and Jacob, all of Engineers, and had to entrust several of his series to selected uncovenanted assistants, amongst whom also casualties were heavy. It is of interest, therefore, to note his views about the Company's military officers that are scattered through his outspoken *Letters to the Duke of Sussex* [317]. Everest—be it remembered—was an artillery officer ;

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[1] from SG. 3-9-40 ; DDn. 402 (114-5). [2] DDn. 286 (180), 10-2-35. [3] DDn. 342 (28-32), 8-6-37. [4] DDn. 371 (112), 4-8-37.

> The main impulse which prompts Englishmen to submit to expatriation to that alien clime is to seek wealth, that they may return with the means of sharing in its delights and comforts to their native land. Compared to this, science is...a secondary consideration. ...
>
> A certain number of youths between the ages of fourteen and eighteen are annually nominated by the gentlemen of the Direction for their army as cadets. ... A portion, selected by no other standard than that of patronage, is sent to Addiscombe, ... another portion to the cavalry, ... and the remainder...to the infantry.
>
> The great prize...at Addiscombe is to get into the Engineer Corps, because the number of lucrative situations in India to which the officers of those corps[1] are exclusively eligible, ... surpasses nearly tenfold that of the advantages within reach of the rest of the army. ... My experience goes to prove that...oft-times very stupid people are found in the Engineers[2], and very clever people in the Artillery. ...
>
> Young men, when they originally come to India in the Engineer corps, have a wide range before them. The building department is theirs to the almost entire exclusion of everybody else. They are eligible to the survey department in common with all their brother officers of the army. They may, if they have interest with the Head of the Government[3], obtain employment in the diplomatic line. ...
>
> With these prospects, it is not matter for marvel that few should direct their attention to the Great Trigonometrical Survey, because it is really *one of the hardest modes of life in any part of the world ; the worst relatively paid*. ...
>
> I will briefly explain...the principles...which it has been my unceasing effort to introduce— First—A clear and free road open to all competitors of all kinds, and no favor. Second—Let talents and fitness form the sole standard by which candidates are to be judged. Third— Whenever a person is found who possesses these requisites undeniably, let no man have the right to gainsay his entrance into the Survey Department, or enquire whether he belongs to this or that branch of the E.I. Company's, or Her Majesty's, army [362][4].

Application made in May 1838 for the services of two young engineer officers was refused, and on Boileau's departure four months later Everest made a further strong appeal, naming four likely officers ;

> It will be long before I can replace Lieutenant Boileau by any officer equally efficient, for, in order to maintain an uniformity of system, I make a rule never to entrust any officer with the conduct of an independent series until he has been trained under my own eye, or under that of my Astronomical Assistant [353–4][5].

Trouble had now started with Afghānistān, and it was impossible to spare any military officers for the survey. During 1839 both Waugh and Jones asked to revert to military duty, but Government ruled that there was "not the least necessity for withdrawing these officers from their present duties". In 1842, however, both Renny and Bontein, the Assistant Surveyor General, were called away, though on Everest's strong protest they were released after a few months [327][6].

During 1840–1 Everest obtained the services of Du Vernet from Madras and Shortrede from Bombay, but neither was a success. Du Vernet never acquired that patience and zeal for meticulous precision that are so essential for geodetic work. Shortrede also was temperamentally unsuited to such work and, try as he would, he never won approval from either Everest or Waugh.

Of all his military officers Everest could only class Waugh and Renny as completely successful, and for both of them he had nothing but the highest praise. "The Hon'ble East India Company have not in their service two higher minded gentlemen more able to do honour to their patronage, or more ready to execute their duty with cheerfulness"[7]. He was entirely content to leave the Great Trigonometrical Survey in Waugh's capable hands [11, 310].

GREAT TRIGONOMETRICAL SURVEY : BOMBAY

In April 1831 Shortrede and his trigonometrical survey of Bombay were placed under the direct professional control of the Surveyor General [14, 72]. Everest called for detailed reports, and suggested that Shortrede should visit him at Calcutta that they might make personal contact for the good of the work. Unfortunately this was not allowed the Bombay Governor, and it was not long before Everest's strong criticisms roused Shortrede's resentment. Though he had been taking great pains over his work, he had little knowledge of the fundamental principles of geodesy and was never able to appreciate the need for all the tiresome precautions on which Everest insisted [72-3].

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[1] one corps for each presidency. [2] thinking of Jervis, no doubt. [3] an obvious hit at Durand, whom Everest had tried to get for the GTS. without success. [4] Everest (108, 111–6). [5] from SG. to PS. to GG., 12–9–38 ; to Mil. Dept., 19–9–38 ; DDn. 342 (227–31). [6] from SG. to Mil. Dept., 27–10–42 ; DDn. 402 (308) ; AG. to SG., DDn. 401 (214), 5–11–42. [7] DDn. 344 (108–84), 3–8–39, para 201.

Early in 1833 William Jacob of the Bombay Engineers was appointed Assistant. He showed aptitude for the work, and was left in sole charge whilst Shortrede was deputed by the Bombay Government on important revenue survey duties, without any notice being given to the Surveyor General [73, 236]. In 1836 Everest protested strongly to the Supreme Government ;

> It is my impression that it has been the unceasing effort of Lieut. Shortrede...to revive the old imperium in imperio under another name and more objectionable form ; to substitute in fact Lieut. Shortrede for Captain Jopp, and to establish...a more thorough independence of my control...than the latter officer ever attempted. ...
>
> The reports...of the Trigonometrical Survey which is conducted by Lieut. Shortrede used to come direct to my office, and prior to the abolition [of the D.S.G.] a sort of regularity and system was growing up. Since that event, they have come in at much longer intervals, and often full of errors. My letters have frequently remained unanswered for months and sometimes, though on points of the greatest consequence, ... totally unnoticed. ...
>
> It is now upwards of 10 months since I have heard from Lieut. Shortrede at all. ...
>
> Lieut. Shortrede's applications used to come through my office in the first instance. Lieut. Jacob's nomination was in this wise. He was mentioned by name in high terms by Lieut. Shortrede, ... and finding on enquiry amongst his contemporaries at Addiscombe that his pretensions as a mathematician were respectable, I had no hesitation in supporting the application, ... certainly not, however, with the view of his being permanently appointed assistant, ... but as the most expeditious means of his acquiring a practical knowledge of the profession.

He pointed out that Shortrede had now asked the Bombay Government for release from the trigonometrical survey on account of his work on the revenue survey, and had been paying but little heed to the Surveyor General of India. He further pointed out that so long ago as 1822 he had himself been employed on the very same series as that of which Shortrede was now supposed to be in charge [72-3, 359];

> It is plain that the trigonometrical operations on the Bombay side...did then form as much part of the G.T. Survey of India as those of the Great Arc, or any other meridional series in the Bengal or Madras provinces. ... I...suggest...that all trigonometrical operations on the great scale, without reference to the part of India in which they are conducted, be alike considered as part of the G.T. Survey of India.
>
> 3rd. That every officer to whom a series of trigonometrical operations may be entrusted, correspond directly with—send his reports regularly to—and comply punctually with all orders he may receive from—my office.
>
> 4th. That only one officer be employed to conduct a series, ... and that he have no other officer...as his Assistant, but that in the event of any other officer being nominated, the work be distributed between them, and each send a detail of his own portion to my headquarters.
>
> 5th. That no officer of the G.T. Survey be allowed to hold a plural situation which can in any way interfere with his duties as conducting a series of trigonometrical operations.
>
> 6th. That Lieut. Shortrede be required either to give up all concern with the trigonometrical survey, or, abiding by it and it alone, to perform the duties of it efficiently.
>
> 7th. That as uniformity...is not only wished by the Hon'ble Court of Directors, but is visibly the only means of bringing a gigantic work of the kind to a satisfactory termination, ... any officer nominated to the Great Trigonometrical Survey shall in the first instance proceed to my own headquarters for the purpose of learning his duty under my own eye, and that my written order be a sufficient authority for any officer of my Department.

The Supreme Government accepted these proposals[1], and in October Shortrede reported that he had handed over to Jacob, though, writes Everest,

> Lieut. Jacob writes to say that he has not been put in charge of the records or public property. ... It is usual when an officer quits my Department for him to deliver every article over to the next senior, and obtain a receipt to be forwarded to my office. ...

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[1] SG. to Mil. Dept., 23-6-36 ; reply, 1-8-36, BMC., 1-8-36 ; DDn. 286 (253-8).

> It seems...proper...that the Surveyor General of India be empowered to correspond direct with the Governor in Council of each Presidency on all matters connected with the surveys[1].

Jacob now spent several weeks on the Great Arc, and Everest reported him

> eminently suited...for the Great Trigonometrical Survey. ... I have rarely seen so young a person with so much practical skill, combined with so ready a comprehension and such facility of applying what he knows. ... I beg to offer my respectful recommendation that Lieut. Jacob be nominated 1st Assistant, and be placed on the same salary as that granted to the other officers, ... viz. 618 sonat rupees per month, besides the military pay and allowances of rank. ...
>
> At the time of his departure from Poona, Lieut. Shortrede was the ostensibly responsible party—Lt. Jacob...the working party. The records, therefore, remained under the controul and at the disposal of the former officer. ... Though Lt. Shortrede informed me, ... 23rd September 1836, that he had sent in the resignation of his situation, ... yet I have received no intimation of that resignation having been accepted. ...
>
> There is little or no method or system on the Bombay side...similar to...this presidency. ... I...[recommend] that Lieut. Jacob...be authorized to organize an establishment on the same scale as that allowed for the meridional series of Raughir and Amua. ... [He] has expressed great anxiety to return to his proper presidency...that he may set about organizing the proposed establishment. ... He will do his best to establish and maintain that uniformity for the sake of which I ordered him round[2].

Sanction was promptly given ;

> As a 1st Assistant to the Great Trigonometrical Survey, Lieut. Jacob...will be considered by the Government of India as exclusively attached to your Department, and you are permitted to equip him with such instruments as he may require, and to allow of his applying to the Hon'ble Company's Mathematical Instrument Maker to have them repaired when necessary[3].

One of the advantages gained was, reports Jacob, "the payment of my establishment in Company's rupees instead of the depreciated currency of Poona, as was formerly the case [354]".

Jacob now re-observed Everest's work of 1822–3 [III, 234–6 ; pl. 18 ; IV, 358], and carried the Bombay Longitudinal Series towards the west coast. When he had to take sick leave after the rains of 1838 Everest reluctantly accepted Shortrede's offer to act for him ;

> I cannot sufficiently regret Lt. Jacob's departure, because he was an officer in whom I reposed great confidence, but...I have had sufficient reason for losing all reliance on Captain Shortrede, and, therefore, I must not only decline...[to] recommend him to be 1st Assistant on the G.T. Survey, but...express it as my opinion that it is better to leave the establishment under...Mr. Sub-Assistant Fraser [383]...than to run the risk...a second time...of work which can only be considered approximate, because the officer conducting it does not think proper to comply with my orders. ...
>
> I believe Captain Shortrede, nevertheless, to be a gentleman of talent, and if...His Lordship would think it desirable to reappoint him, ... I...suggest...that he be ordered in the first instance to my headquarters to obtain a practical knowledge of...conducting trigonometrical operations[4].

Shortrede thereupon promised to work "in such a way as to meet the approbation of Colonel Everest by a strict and punctual obedience to his orders", and though his outturn of field work during the next year was of little importance, Everest was so far satisfied that he accepted him for regular appointment to the G.T.S. Having handed back to Jacob in May 1840, Shortrede reported to the Surveyor General's camp at Sironj in November when Everest and Renny were observing for zenith distance [100]. During the march to the north, Shortrede was employed on minor triangulation without distinguishing himself [80], and after the rains of 1841 was given charge of the Karara series. He was, however, no more a success than he had been in Bombay, and after much stormy correspondence he dropped out of the Department in 1845.

With the view of keeping the Bombay officers in close touch with work in other parts of India, Jacob joined Waugh on the re-measurement of the Bīdar base-line in November 1841 [55], but poor health prevented his paying an extended visit to Dehra Dūn as Everest had suggested. On his return to Bombay he secured the appointment of Harry Rivers, also of Bombay Engineers, to work under him for some months before taking over in January 1843. Jacob then took furlough, and eventually succeeded Taylor as Astronomer at Madras [115].

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[1] DDn. 286 (388), 4-11-36. [2] DDn. 342 (1-3), 3-1-37. [3] BMC., 6-2-37 ; DDn. 341 (100-1). [4] to Mil. Dept., 2-11-38 ; DDn. 342 (249-50).

TOPOGRAPHICAL SURVEYS : BENGAL

As already noted, the only surveyors working directly under the Surveyor General in the Bengal Presidency in 1830 were Boileau in Bharatpur, and Wilcox and Ommanney on the lower Brahmaputra [2, 265, 271][1]. The two latter drew pay as river surveyors for the upkeep of their boats [I : 270 n. 1 ; IV, 364]. With much difficulty the Surveyor General obtained authority for Wilcox to draw his full allowances whilst in Calcutta assisting on the base-line measurement [352-3].

> I found he was a person on whose discretion I could place...entire reliance, and [as] he had toiled very hard for the more active season of the year I sanctioned his coming to Calcutta in September last for a few days. I availed myself...of his being thus temporarily at the Presidency...to detain him...that I might employ his services in the late measurement of the base, ... and...the result has fully established the judiciousness of my selection. ...
>
> He has for the last two months led a life of severe toil, having been actively engaged from sunrise to sunset in the field, and his journeys to and fro have compelled him to incur expence for conveyance to the scene of his labours. ... I therefore beg...that His Honor in Council will...sanction the payment of the whole of Captain Wilcox's salary as a River Surveyor[2].
>
> Besides the duty in which I employ Captain Wilcox, he had diligently devoted all his leisure time in protracting the plans of his own survey. ... If any alteration is made whatever in the allowances of Captain Wilcox, they ought rather to be increased than diminished. I find difficulty enough already in meeting with gentlemen who have both ability and inclination to engage in the duties of the Great Trigonometrical Survey, and...the only way...is to encourage by indulgence such officers as are really fit to do justice to the great work[3].

Government refused Everest's request for authority over all officers who might be employed in surveying [295-6], though

> all surveys in the regular department...will continue to be made under the instructions of the Surveyor General, and the officers so employed are distinctly placed under his authority. But, with regard to officers employed in the Political Department, considerable inconvenience might be experienced if...required to conform to the directions of the Surveyor General. ... Government would thus be deprived of much useful...geographical matter, if none were to be received but what would be deserving of the Surveyor General's authentification[4].

Though several surveyors were employed on distant frontiers or beyond, for political or military purposes, and though many surveys of roads, cantonments, and canals, were made by departmental officers [267, 269], the only officer placed under the Surveyor General's orders for topographical surveys appears to have been Henry Kewney [268], who would have been tried in the G.T.S. if his unit could have spared him. Everest was not consulted on the employment of Broome and Cunningham in the western Himālaya [269], nor on the appointment of Durand and Anderson as surveyors with the Army of the Indus [281-2].

The following extracts from *Pay and Audit Regulations* of 1835 were of interest to surveyors ;

> Boat Allowance, per month,—Lt. Colonels, Rs. 450—Majors, Rs. 360—Captains, Rs. 180—Subalterns, Rs. 100. ... During the absence of the Surveyor General from the Presidency on duty, he is entitled to draw, for the period occupied in proceeding by water, the boat allowance of his rank[5].
>
> The following, not having house-rent consolidated in their staff allowances, and their residence in Calcutta being rendered necessary by the nature of their...appointments, draw house-rent of their rank; ... Surveyor General. ... Increased rates of house-rent are granted to Staff Officers at the Presidency holding the following appointments—... an addition equal to 50% on the ordinary rates—... Assistant to the Surveyor General. ... The Surveyor General draws house-rent in addition to office rent[6].

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[1] All three were posted to the GTS. in 1832 or later [353, 355]. [2] DDn. 283 (18-22), 25-1-32. [3] ib. (72-4), 7-5-32. [4] B Pol O. 2-12-31 ; DDn. 263 (359-63). [5] Amended later to allow *equivalent* of boat allce., when absent from Presidency [328-9]. [6] *Pay Regns.*, 1835 IV, XVII.

The following officers are prohibited from assuming military command by virtue of their commissions—Surveyor General's Department—Revenue Survey[1]. ... Officers deputed on survey are exempt from any military duties unconnected with such survey.

No new survey is to be undertaken at any subordinate Presidency without the sanction of the Supreme Government, in order that the Surveyor General may be able to report on its expediency, the qualifications of the surveyor, and the capability of his instruments.

The Surveyor General is...to name the scales which shall be used, and the...manner of preparing the Memoir of the Survey. ... No survey will be admitted by him as complete unless accompanied by a documentary explanation of its...construction [III, 194–5, 284].

Paper and other materials necessary for drawing will be drawn for as actually purchased by bills to be audited before payment.

The office of Surveyor General being for all India is open to officers of every Presidency[2].

TOPOGRAPHICAL SURVEYS: MADRAS

In 1830 the officers in charge of the three Madras topographical parties, Ward, Snell, and Morland, and two assistants, Du Vernet, and Hill, worked under Montgomerie, Deputy Surveyor General at Madras. From July 1831 Morland's party in Hyderābād State, or Nizām's Dominions, was transferred to the control of the Surveyor General as also were the other two from 1st September 1833 when the post of D.S.G., was abolished [2, 248, 328].

The selection of officers for these parties was made by the Madras Government from officers of that Presidency. The Surveyor General was not consulted, and some of the officers posted later had no previous knowledge of survey whatever [254, 258]. In spite of Mackenzie's earlier orders [III, 317], it became the regular practice of these officers to style themselves "Assistant Surveyor General".

Benjamin Ward was the last of Mackenzie's surveyors, and had been apprenticed at the observatory surveying school in 1798 [II, 352]. His health had suffered from long years spent in the forests of South India, and when he had to revert from the survey after promotion to major in 1834, he retired to the Cape where he had married in 1825. He died the following year.

Snell was the last of the officers educated at the Military Institution [II, 321] and left the Department on 30th June 1835.

Morland had been first appointed assistant in the Hyderābād party in 1828, succeeding to charge the following year. He continued in charge till 1848, with breaks for furlough, sick leave, and regimental duty.

Du Vernet joined Ward's party as assistant in 1828, and took charge of the Hyderābād survey when Morland took leave in 1832. He had to revert to his unit in 1835 on promotion to captain, and then took furlough. After a period of regimental duty on his return, he was posted to the G.T.S. in 1840, and served till 1854.

Thorold Hill had joined Snell's party as assistant in 1828, and after a year in Nellore had been several months on military duty in Kimedi, Ganjam [253]. He took over charge of Ward's party on 1st November 1834, having unsuccessfully applied for appointment to the G.T.S.;

> I have every season, independent of assisting in the trigonometrical operations, surveyed with the plane-table an equal portion to any of the sub-assistants, a custom which I have lately heard does not prevail with the assistant officers of any other survey, and which...in a climate like that of the Carnatic greatly augments the toil and labour.
>
> Being the senior assistant on this side of India, I am anxious...to exchange...for the more scientific operations of a charge. ... The survey of the Southern Provinces (Trichinopoly, etc.) will become vacant by the promotion of Captain Ward in about 12 or 15 months. I... hope that, if my services are not required by you in Bengal, I may look forward to gratifying my ambition when that event takes place[3].

In 1835 he was again sent up on military duty to Ganjam to survey the hilly jungle country that was the scene of local disturbances, and he carried on under the Commissioner till 1841 when he took furlough on medical certificate [254–5].

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[1] *Pay Regns.* IV, XXIX, para 39. [2] ib. (723). [3] DDn. 282 (665–7), 1–7–33.

Samuel Macpherson, with no previous survey experience, was posted as assistant to the Hyderābād party in 1831, and took over the Nellore survey on Snell's departure. In 1839 he took leave to the Cape, and on his return was sent on political duty to Ganjam, where he had worked for a few months under Hill in 1836. He later took part in the suppression of the Merriah human sacrifices [254].

John Campbell and Thomas Ryves were brought in after 1836, and succeeded to charge of the Salem and Nellore surveys [251-3, 255].

Everest was just as staunch a champion of the value of infantry officers as Hodgson had been [III, 330-1], and he mocked at proposals made by Jervis for importing Engineer officers and n.c.o's from England [317, 356-7];

> The late Colonel Mackenzie excepted, my office records show no instance, that I am aware of, of any but infantry officers having been employed in the Survey Department under the Madras Government[1], and yet it is universally undenied that the topographical system of that Presidency surpasses all others in India. ..
>
> Major Jervis's survey of South Konkan...is...at this instant lying on my desk, and it does not contain much to boast of [307-8]. If I hear any more of this, ... I may...take up the cause of my subordinates, and commence by contrasting that gentleman's performances with those of the infantry officers whom he holds so cheap ; for, though not of that branch myself, I will not sit quietly by whilst injustice is perpetrated towards a gallant body of my fellow-soldiers, whose natural protector I am[2].

REVENUE SURVEYS : NORTH WESTERN PROVINCES

In 1831 the following military officers were employed on revenue surveys in the Western, or Upper Provinces of Bengal [214] ;

James Bedford	...	... Sahaswān ...	first appointed	1821
William Brown	...	... Sahāranpur ...	,,	1822
Birnie Browne	...	... Morādābād ...	,,	1822
John Simmonds	...	... Delhi ...	,,	1823
George Fraser	...	... Sahāranpur (assistant)	,,	1826
Roderick Macdonald	...	... Sahaswān (assistant)	,,	1828

In 1832 Bedford, the senior, was appointed Deputy Surveyor General in place of Herbert, with headquarters at Allahābād [321]. Reporting on qualifications for transfer to trigonometrical survey [353], Herbert considered

> Captains W. Brown and Bedford the most able ; Captain Simmonds is zealous and not deficient in intelligence ; of Lieut. B. Browne I know rather less ; ... Lieutenants Fraser and Macdonald I consider as well fitted for employment, and they are both desirous of obtaining it[3].

Only Macdonald was taken for the G.T.S. [3, 61]. To meet the expansion of the revenue surveys that followed in 1833 [213-4], a number of new officers had to be recruited and there was such competition, especially amongst artillery officers, that the Governor General kept his own roster of candidates. The first two places went to Robert Wroughton, who after eight years on the Gorakhpur survey, had been reverted to regimental duty [III, 152 ; IV, 214, 222], and to Henry Lawrence, of artillery, a young man of ideas and personality, who soon attracted the notice of the Board of Revenue [216, 225]. Other Artillery officers included Fordyce, Rind, James Abbott, Brind, Shakespear, and Maxwell ; most of them reverted to military duty during the Afghān war [215, 225]. Of infantry officers, Saunders Abbott and Walter Sherwill were particularly useful.

When Simmonds took his party down to Azamgarh in 1833 [223-4], Bedford found him most difficult to deal with, and complained that he raised constant

> frivolous objections and difficulties...where none have ever been hinted by other surveyors, and his recent pertinacity in continuing an useless discussion after I had modified the monthly journal expressly to accommodate him...proved so serious an interruption and annoyance. ...
>
> To relieve surveyors from...furnishing a monthly copy of their field notes...before their bills could be passed, a short form of journal was issued...in 1823, and since continued in general

---

[1] Arthur [II, 376-80], De Havilland [II, 393-4], Davies [III, 436-7], all Engrs. ; Morison [II, 431]; Art. ; Montgomerie [III, 485], Cav. [2] Everest (83-4). [3] DDn. 264 (233-6), 9-9-31.

use, until further curtailed by myself in December last. ... For the month of February Captain Simmonds sent his journal without anything to show where the operations were in progress, and also with a large portion of the dates omitted. It was returned for correction.

To further suggestions intended to be helpful, Simmonds retorted in a manner "equally improper and disrespectful". In spite of orders which Bedford conceived "to have ended the matter", Simmonds expressed "his determination to shorten field work one day each month if a form of journal, already given up, were required from him". Eventually Bedford passed all the correspondence to Government, remarking that he had "experienced more trouble and annoyance from...this one survey or than with all the rest together". Government declined to read through the lengthy correspondence, and told Bedford to "issue his orders to Captain Simmonds, and require him to obey them, and if he should neglect to do so...represent his conduct to Government"[1]. Simmonds obtained a transfer to the Clothing Department a few months later.

For charge of a second party for Azamgarh Government accepted Bedford's recommendation, in preference to that of the Board of Revenue, to appoint Terranneau, an uncovenanted civilian, rather than Fordyce, from the

present Azimgarh survey, where the progress...has been so slow that there is every fear of still greater delay in the event of Captain Simmonds being deprived of his aid [223-4]. ... Of Lieutenant Fordyce. ... I think favorably, but he has very little experience, ... and chiefly on a survey where the progress has been very slow. Were other claims...equal, I should ...have deemed it by no means expedient to recommend him for the charge of the new survey, on which a much more rapid progress was expected than he had been accustomed to observe[2].

The constant raising of new parties at short notice made it difficult for Bedford to give his junior officers sufficient previous experience for such responsible charges, and he had constant disputes with the Revenue Board regarding their promotion [214]. In the case of Terranneau the Board most certainly got the better of the argument, for after his transfer to Bundelkhand a serious discrepancy was found in his Azamgarh survey [224-5], and the Board called attention to their earlier opinion,

now so unfortunately established, that he did not possess the mental vigour requisite to wield a large establishment. ... Their position gives them the means of forming...a better judgement ...than even Captain Bedford, as they look to very different qualities than mere mechanical skill in surveying [230]. ... Mr. Terranneau would be more useful to the survey under another officer of more energy of character than when left alone to his own resources. ...

In such men as Lieut. Lawrence, Captain W. Brown, Captain Wroughton, and Lieutenant Fordyce, they can have entire confidence[3].

Bedford would not readily admit defeat, and protested to the N.W.P. Government against the latest selections made by the Board ;

Captain B. Browne is still passed over, and Captain Fordyce selected, whose progress has not hitherto been such as to lead me by any means to the conclusion placed on record by the Board. His work seems good but slow, and his general health is not such as to warrant the expectation of this great exertion, even if any officer were equal to it[4].

Fordyce fully justified his promotion, and the general health of the revenue surveyors did stand up to the strain of conducting operations with "double establishments", in spite of Bedford's pessimism [216 8].

The general distribution of surveyors between 1830 and 1842 is shown on plate 11. By 1842 all parties in the N.W.P. were closed down, except those of Maxwell and Stephen, which went to the Lower Provinces. The other officers were replaced at the disposal of the Commander-in-Chief, the last being Wroughton and Brown at the end of October 1842 [229].

REVENUE SURVEYS: LOWER PROVINCES

Alexander Hodges held charge of the revenue survey of the Sundarbans from 1828, and extended work into Noākhāli District and down the Meghna till he resigned at the end of 1835. Henry Siddons, one of the few Engineer officers to be employed on these revenue surveys, held charge of the Chittagong survey from 1834 till 1840, [194 7]. With the support of the Commissioner, both he and Hodges drew allowances as River Surveyors for the upkeep of boats [360] ;

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[1] BTC., 5-5-34 (26). [2] from DSG. 1-8-34 ; BTC. 29-9-34 (94). [3] NWP. Rev. Bd. 11-7-37 (28). [4] ib. 20-10-37 (76).

> They had, during the cold and hot seasons, not allowed themselves rest or time to prepare the protracting of the mouzas surveyed after staying out until a very late period. They are now working all day in the preparation of the areas.
>
> Captain Hodges, however, and his predecessors in the Soonderbuns always did draw the full allowances all the year round. He did so last year, and I can hardly think that, in the transfer...to the Bullooah District, after years of exposure to the Soonderbuns climate, it was intended to expose this officer...to a loss of emolument.
>
> It is in this district absolutely necessary for the Surveyor to keep up boats to move his establishment and himself, as well as tents to reside in, in inland places. ... During the season they strain every nerve to survey as much land as practicable in a particularly difficult part of the country, and during the rains they are...bringing the results...into that shape which will be useful to the Revenue Authorities[1].

The higher rate of allowance was only authorized for seven months of the year in spite of the Commissioner's further representation that

> Lieut. Siddons is...compelled to hire boats at a very heavy expense to convey himself and his baggage to and from the places under survey. ... He is always obliged to keep a boat ready, and...the only part...in which.. he can move without boats is in that narrow strip of land between the Fenny and Chittagong north and south, and the sea and Seetacoon range of hills west and east ; through this tract the public road runs. ...
>
> If any officers are to be...River Surveyors, and to draw the allowances as such, the Surveyor... of the islands in the Megna ought to be so. ... There is not only the necessity of keeping boats of a very superior description, but a great probability of losing them should a storm occur [III, 139, 425]. ... The large salt sloops never venture in the channels about Hattia and Sundeep during the springs. ... The Surveyor must be prepared to cross them at all times and seasons...to check...the measurements...carried on by his assistants[2].

Siddons spent on his boats—cutter *Louiza*, and jolly-boat, complete, Rs. 1,800—*pansway*, Rs. 42—bill for keels, log-lines, etc., Rs. 83.

Most of the surveyors in Bihār and the lower provinces came from the artillery, Egerton, Ellis, Thuillier, Trower, Smyth, and Phillips. From the infantry came Hodges and Mathison. At the end of 1837 James Fraser of the engineers, then serving in Cuttack, was appointed to organize the surveys in Orissa, but had to take leave on medical certificate before they got started. Thuillier and Smyth had long careers in the survey, and collaborated in preparing a *Manual of Surveying for India* that stood as the departmental handbook for revenue surveys for many years [III, xxii ; IV, 232]. Thuillier became Surveyor General and left a son to become Surveyor General also, and a grandson to follow in revenue surveys[3].

All these surveyors, except Hodges, Siddons, and Fraser, were posted as assistant surveyors deputed on a temporary footing. Trower complains that

> officers in charge of surveys in the North West Provinces receive more than double the salary, as well as contingent allowance, ... for a charge of precisely the same nature and responsibility, at the same time that the work here requires great labour and closer supervision, from the exceeding intricacy of the division of the land. Also the climate is more enervating to the European constitution. ... It is...necessary to pay the ameens five times the amount given there for measuring the same piece of ground.
>
> The present salary allowed here is Rs. 250 per month. By leaving my regiment I lose Rs. 100 of my own military allowances, Rs. 150 is consequently the only remuneration received for this office, which is one requiring exceeding care and constant fatigue. ... An allowance of Rs. 100 for contingencies, but which does not cover the expenses actually incurred [347][4].

When Trower applied for two years leave on medical certificate, it was ruled that

> an officer appointed to...a particular survey must be regarded as being upon temporary deputation, and not as...holding a permanent staff appointment. ... It might be objectionable to grant an officer leave in case of sickness for...even three months, ... because in that time...

---

[1] from Comnr. 22-7-35 ; BRC. 15-8-35 (7). [2] from Comnr. 5-9-35 ; BRC. 29-9-35 (16). [3] H. R. Thuillier (1838-1922) ; SG. 1887-95 ; L. C. Thuillier (b. 1877), s. of I., 1902-32. [4] from Trower, Puri, 10-9-38 ; BRC., 18-9-38 (17).

> another officer would not be prepared to continue this work ... An application for leave must...be treated as a resignation of deputation[1].

Bedford appealed against this decision, quoting a rule of 1823 [III, 348-9], but Government stuck to their ruling ;

> Lieutenant Fraser, an Engineer officer, ... draws the regular absentee allowance as a matter of course. ... Appointments to temporary surveys like that of Cuttack, assimilate more to officiating...appointments. ... The officers...perform a particular service which, if they... are incapable of executing, must be performed by another one on the same terms.
>
> The surveyor of a particular tract, district, or set of districts, in Bengal seems...to be on a different footing from an officer attached to the Survey Department of the N.W. Province[2].

Bedford courageously returned to the charge ;

> There appears to be no real difference between the Revenue Surveyors of the Upper Provinces and those of Bengal, but what obviously tends to disadvantage of latter. With the same ardous duties to perform, they were nominated on salaries less than half that of a full surveyor in Upper India—Rs. 250 in Bengal—Rs. 526 in Upper India—and employed in districts generally speaking far more injurious to health.
>
> Already Lieutenant Egerton has been compelled to seek for restored health in his native land, and to sacrifice...promotion to full allowances, ... which his zealous exertions so well merited. Lieutenant Mathison is at this moment continuing his survey in Hijellee whilst the cholera is raging round his camp. ... At the end of last season, ... at Mongheir, all four of Captain Ellis's assistants were driven from the field by fevers, and obliged to proceed on the river for their health[3] [III, 455].

Government surrendered ;

> Upon a reconsideration of the whole subject, the Governor General in Council is now inclined to the opinion that the Surveyor in Bengal, not being an officer appointed for the performance of some single survey of brief temporary duration, who in the faithful discharge of his duty has contracted those diseases to which the nature of his occupation renders him peculiarly liable, is entitled to the same...indulgence which is allowed in the Upper Provinces, and should lose, not the whole, but a portion only, of his staff allowances when absent on sick certificate.

A formal order was thereupon issued[4]. As an anti-climax, the Directors refused their consent, "the leave rule published inc *Calcutta Gazette* is rescinded"[5].

Sherwill explains the leave rule followed in the N.W.P. ;

> When a military Staff Officer leaves his office, the officer put in to act for him receives half the staff allowance in addition to...usual pay. ... G.O. of GG. 31st August 1838.
>
> When Captain Lawrence went away, Abbott drew one half, 263 rupees, as acting for him. When Abbott went away, Stephen drew the same[6].

The following allowances were drawn by revenue surveyors [III, 349-50] ;

> The regular allowances of a Surveyor are rupees 618 per mensem in the field, and rupees 250 during the recess, or, as it used to be called, the protracting season. In 1833 the Governor General...authorized a fixed monthly salary of rupees 526, being the average of the field and protracting allowances, and this has ever since been the established allowance of Surveyors in the N.W. Provinces [346, 348].
>
> Under the old system, when a surveyor was absent on sick leave, he was permitted to draw the recess allowance of rupees 250 by the special Survey rule of the 10th July 1823 [III, 332], but since the establishment of average monthly salaries, Surveyors in the case of authorized absence...have been allowed to drew a moiety of their salaries. ...
>
> The salary of an Assistant Surveyor is rupees 250 a month. If placed in charge of a survey during the absence of the Surveyor, he draws the forfeited half of the Surveyor's salary in addition to the half salary of his own appointment. This is also the General Staff rule, and under it Lieutenant Sherwill will draw his allowance of Rs. 388. ...
>
> The Surveyors in Bengal (with the exception of Lieutenant Siddons)[7] at first drew only the allowances of Assistant Surveyors. ... On the representation of Major Bedford, supported by the Board, the Government were pleased, under date the 25th July 1839, to grant them the allowances of *Assistant Surveyors in Charge*, or Rs. 388, and to Lieutenant Thuillier, as the reward of peculiar merit, the salary of a Surveyor in the N.W. Provinces, or rupees 526[8].
>
> The salaries of Lieutenant Mathison, and Lieutenant Smyth, and Mr. Fitzpatrick, were raised to the same scale by Government orders dated 30th March 1841[9].

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[1] BRC., 26-9-39 (13). [2] BRC., 12-5-40 (28). [3] from DSG. 11-2-40 ; BRC. 12-5-40 (62). [4] Council Chamber, Govt. of I ; 23-3-40 ; *CG.* 4-4-40 ; BRC. 12-5-40 (53) ; DDn. 410 (84). [5] BRC. 19-12-42 (5). [6] DLR. 37/82 (81), Gya, 14-7-42. [7] being an Engr., he was qualified for full allce. [8] BRC. 25-7-39 & 30-3-42. [9] from Rev Bd. LP. 20-1-43 ; BRC. 6-2-43 (12).

The surveyors employed in the Lower Provinces in January 1843 were ;

Lieut.	H. Thuillier	...	Rs. 526	Permanent	Căchăr, deputed to Patna.
„	W. Maxwell	...	263	on leave	Patna ; on mil. duty.
„	W. S. Sherwill	...	388	Temporary	Assistant in ch. Behar Survey.
„	H. V. Stephen	...	263	on leave	Behar ; on mil. duty.
„	R. Mathison	...	526	Permanent	Midnapore.
Mr.	J. Fitzpatrick	...	526	Permanent	Purneah.
Lieut.	R. Smyth	...	526	Permanent	Cuttack.

These officers are set down as permanently employed, although their respective surveys are rapidly drawing to a close, because, had the survey of the settled provinces continued, so also would their employment[1].

REVENUE SURVEYS : BOMBAY

Though Jervis's survey of South Konkan had been suspended from 1st June 1830 [III, 172–3] his assistant Dowell had remained on duty with the Collector of Ratnāgiri, assisting "in various ways connected with the management of the district, with all the details of which he is intimately conversant". In February 1833 he was nominated for duty under the Collector of Poona to check the measurements of Pringle's survey [III, 439 ; IV 436 n.2] ;

> His Lordship in Council conceived that, from the experience which that officer had acquired, he will be able to throw much light on the Deccan survey and assessments, and to ascertain by measuring a few villages...surveyed by Mr. Pringle, whether the measurement is correct and fair, and to report how those employed under that gentleman have executed the work[2].

Dowell had, however, already been granted a medical certificate, and died on his voyage to England four months later. It was under these circumstances that Shortrede was called away from his triangulation, and employed on testing Pringle's work [230, 358]. On proof of the untrustworthiness of Pringle's measurements [235–6], instructions for a new survey were issued in March 1837 ;

> The success of the survey depends so completely on the conduct of those to whom it is entrusted that, in his selection of the military officers to be employed, the Governor in Council has been led more by their reputation for temper, discretion, and knowledge of the native languages, than by their proficiency...as surveyors. ...
>
> To ensure regularity of system, ... Government have selected Lieut. G. Wingate, whose civil situation...Assistant to the Principal Collector of Poona, will remove all difficulty about his military rank. Lieut. Wingate is, therefore, appointed Superintendent of the Revenue Survey in the Deccan, with an increase of Rs. 150 per mensem to his present allowances. ...
>
> The Governor in Council has been pleased to appoint as his assistant Mr. W. H. Bell—formerly of the Engineer Institution [III, 384]—on a salary of Rs. 200 per mensem.
>
> The surveying officers should proceed immediately to...place themselves under...Lieut. Wingate, who will keep them together, and employ them in one district until they are thoroughly acquainted with the duties and, as they become available, ... the Principal Collector should assign them districts. ... The surveying officers should continue...for at least two seasons in the same talooka, till...sufficiently experienced for an independent charge. ...
>
> Staff pay...is fixed at Rs. 200 each per mensem, with...office allowance...Rs. 75 per month. ... Until Lieut. Ayrton passes in the Marhatta language, and until the other officers be reported competent...by Lieut. Wingate, a moiety only of this...is to be drawn, but...the full amount with arrears is to be drawn if this ordeal be passed within six months[3].

The officers thus appointed, in addition to Alexander Nash of Engineers already on revenue survey, were Ayrton and Gaisford of Artillery, and Bellasis, Diggle, Wells, Davidson, and Robertson of Infantry [236], all but Ayrton and Diggle being found competent to drew full staff pay with arrears from date of appointment. In January 1839 the Revenue Commissioner reported that all had passed an examination in the Marātha language except Wingate and Davidson ;

> Colloquial knowledge obtained by Lieut. Wingate...is quite sufficient to enable him to conduct his public duties, and...this officer both speaks and reads Maharatta with great fluency. ... Lieut. Davidson...has acquired a sufficiently extensive acquaintance with it. ... At the time...Lieut. Davidson joined the survey no intimation was given to him regarding his having to undergo examination[4].

---

[1] BRC. 6–2–43 (13), 21–1–43. [2] from Rev. Comnr. BO RC. 517/1833 (51–2), 20–2–33. [3] BO RC. 8/1837 ; 23–3–37. [4] BO RC. 1054/1839 (277–9), 8–1–39.

During 1841 progress was cramped by the recall of several officers to military service during the Afghān campaign, and Wingate writes in September that

> six officers, viz., Lieutenants Gaisford, Robertson, Captain Stather, Lieuts. Fenning, Pelly, and Forbes, were withdrawn...to join their regiments on field service. ... The establishments of two absent officers were transferred to Messrs. Bell & Price [306], the latter being at the same time appointed acting Assistant Superintendent, andt he allowance for native establishment to Lieut. Nash, and Captain Landon, and myself, increased from Rs. 500 to 700 per mensem. ...
>
> The progress...is, of course, very different from what it would have been had no officers been withdrawn, but it is yet considerable[1].

About the same time he drew attention to

> the inadequate remuneration of the European officers, ... a striking contrast to...the revenue surveyors of the North West Provinces, where...the most able...officers in the civil and military services are retained by...a liberal and graduated scale of emolument. In the Deccan survey, on the contrary, there is no prospect whatever of advancement. ... We shall vainly expect to prevent a constant...succession of changes among the European officers...while the emoluments...of their appointments continue in every respect inferior to those of the most subordinate grades in other departments[2].

The Directors had questioned the propriety of allowing military officers any hand in the settlement of revenues, but accepted the explanations given [239] and approved a revised scale of allowances ;

> To Lieutenant Wingate as Superintendent of the survey, an allowance of rupees 600 per mensem, with an additional allowance Rs. 100 so long as he shall exercise the functions of an assistant Collector in addition. ...
>
> To each of the officers employed as Assistant under him, after having completed a service of two years in the department, and...qualified to take independent charge of a survey, an allowance of Rs. 500 per mensem. And to all other officers...of less than two years in the department, and until...qualified for the independent charge, ... Rs. 250 per mensem.
>
> These consolidated allowances are to be inclusive of every item...whatsoever, ... with exception of the amount allowed for establishment, and the increases are to take effect from the date of the receipt of this despatch[3].

In November 1841 Wingate took leave to Europe, and Nash took over charge reporting that his assistants were

> Capt. Landon, and Messrs. Price & Bell, who had been employed in the preceeding season, and Lieut. Wells, who had been appointed just in time to take charge of the establishment employed under me when assistant. ... In the following month Lieut. Evans was appointed...and attached to Lieut. Wells...to learn his duty, but almost immediately...Lieut. Wells himself was ordered...with his regiment to Sinde, and thus the superintendence...devolved on Lieut. Evans before he had more than a few days experience[4].

By August 1842 five of the nine assistants were absent on military service, but after some discussion it was decided to continue to employ military officers in spite of the risk of their recall to military duty after learning their work [306-7].

NOMINAL ROLLS[5]

GREAT TRIGONOMETRICAL SURVEY

Name		Corps	Appointment G.T.S.	Previous Survey	Remarks
BOILEAU, A	...	Ben. Engrs.	April 1832	Topo. Svy., Allahābād-Agra, 1827-8 ; Agra-Bharatpur, 1828-32.	resd. 24-12-38.
BRIDGMAN	...	Ben. Art.	12-3-32	...	d. at sea, 17-4-35.
DU VERNET	...	Mad. Inf.	18-3-40	Topo. Svy., Malabar, Madura, Hdbd., 1828-36 ; resd., 1836.	resd. G.T.S., 1854.
EVEREST	...	Ben. Art.	26-12-18	Route Svy., Java, 1813-5 ; Telegraph Svy., 1817-8.	STS., 24-1-23 ; SG. & STS. 8-10-30 ; resd. 16-12-43
GARFORTH	...	Ben. Engrs.	13-10-43	... ...	resd. Aug., 1847.
JACOB	...	Bo. Engrs.	14- 1-34	... ...	resd. 11-1-43 ; Mad. Obsy. 1848-49.
JONES	...	Ben. Engrs.	4-5-35	... ...	resd. Oct., 1840.
MACDONALD	...	Ben. Inf.	12-3-32	Rev. Svy., 1828-32.	resd. 1-9-35.

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[1] BO RC. 1414/1842 (49-50), 29-9-41. [2] *Rev. Svy. (India)*, 1853 (376). [3] BO RC. 1416/1842 (13-4), 6-12-42. [4] ib. 1414/1842 (127-9), 7-9-42. [5] v. Biog. Notes except for Bo. Rev. Surveyors.

Names	Corps	First Apptg.	Employment	Remarks
OMMANNEY	Ben. Engrs.	7-1-35	Road Svy., 1929-30; Topo. Svy., Brahmaputra R., 1830-4.	resd., 1-5-37.
RENNY	Ben. Engrs.	23- 7-32	... ...	ret., 1-1-54.
RIGHY	Ben. Engrs.	7- 1-31	... ...	resd., Aug. 1831.
RIVERS	Bo. Engrs.	10- 6-42	... ...	resd., 1853.
SHORTREDE	Bo. Inf.	10-10-38	Deccan Topo., 1824-8; Bo. Trig., 1828-36.	resd., 1845.
WAUGH	Ben. Engrs.	2- 7-32	... ...	SG. & STS., 16-12-43 to March 1861.
WESTERN	Ben. Engrs.	7- 1-31	... ...	to S & M., 6-9-34.
WILCOX	Ben. Inf.	27- 2-32	Rev. Svy., 1823-4; Geogl. Svy., Assam, 1824-8; Topo., Brptra. R., 1828-32.	Astronomer, Lucknow, 5-2-35.

TOPOGRAPHICAL SURVEY : MADRAS

CAMPBELL	Inf.	26- 1-36	ch. Salem., 1836-44.	to mil. duty., March 1844
DU VERNET [367]	Inf.	5- 2-28	Malabar, Madura, 1828-32; Hdbd., 1832-3; ch. 1833-6.	resd., 1-2-36; to GTS. 1840.
HILL	Inf.	2-10-29	N. Circārs, 1829-32; Nellore, 1832-33; Ganjam, 1833-4; ch. Trichinopoly, 1834-6; Ganjam, 1836-41.	furl., 1841-5; GTS. Feb. 1845.
MACPHERSON	Inf.	24- 6-31	Hdbd., 1831-5; ch. Nellore, 1835-6; Ganjam, 1836-7; Nellore, 1837-9; 1841.	resd., 1841.
MONTGOMERIE	Cav.	9-11-24	MMI., 1810-2; Mil. Svy., 1816-7; Deccan, 1821-2; DSG. Madras, 1824-33.	to mil. duty 1-9-33.
MORLAND	Inf.	12- 2-28	Hdbd., 1828; ch. 1829-32; 1836-48.	resd., 1848.
RYVES	Inf.	7- 7-40	Hdbd., 1840; ch. Nellore, 1840-2.	to mil. duty, 29-10-42.
SNELL	Inf.	3-11-20	MMI., 1808-9; 1814-6; inch., N. Circārs 1829-32; Nellore, 1835-5.	resd., 1-7-35.
WARD	Inf.	...	Obsy. Sch., 1798-1800; Mysore & Ceded Dists., 1800-9; Ens., 1809; Mad. DO., 1811-5; ch. Topo. Svys., 1816-34.	resd., April 1834.

REVENUE SURVEYS : BENGAL

ABBOTT, J.	Art.	Oct. 1835	Muttra; ch. Bareilly, Feb. 1836.	to mil. duty, Sept. 1838.
ABBOTT, S.	Inf.	Jan. 1837	Grkpr. & Cawnpore, 1838-9; Banda & Jaunpur, 1840; Jhānsi, 1841-2; Jalaun, 1841.	to mil. duty, Oct. 1842.
BEDFORD	Inf.	1821	ch. Sahaswān, 1822-32; mil. duty Assam, 1824-6; DSG. Allbd., 1832-7; Calcutta, 1838-42.	ret., 1-1-43.
BRIND	Inf.	April 1836	Aligarh; ch. Azamgarh, Gorakhpur, 1837-8.	to mil. duty, Sept. 1838.
BROWN	Inf.	1822	Delhi, 1822-6; ch. Upper *doāb*; 1826-37; Hissar, 1837-8; DDn., 1838-9; Sikh States, 1841; Mussoorie, 1841-2.	to mil. duty, Oct. 1842.
BROWNE	Art.	1822	ch. N. Moradābād, 1822-42; mil. duty, Cāchār & Burma, 1824-6.	to mil. duty, 1842.
EGERTON	Art.	1835	ch. Monghyr & Bhāgalpur, 1835-8; Bijli, 1838-9.	resd., Aug. 1839.
ELLIS	Art.	1837	ch. Monghyr & Bhāgalpur 1837-40.	resd., 15-11-40.
FERGUSSON	Inf.	1838	Cawnpore, 1838-9; Ghāzipur, 1839-40.	resd., Oct. 1840.
FORDYCE	Art.	1833	Agra 1833-4; Azamgarh, 1834-6; with ch. from 1835: Gorakhpur, 1836-8; Agra, 1838-40.	resd., 1840.
FRASER, G.	Cav.	1826	Upper *doāb*, 1830-2; ch. Bareilly, 1832-6.	resd., Feb. 1836.
FRASER, J.	Engrs.	1837	Orissa, 1837-8	leave on mc., 23-3-38.
GRANT	Inf.	1838	Allahābād, Bānda, Hamirpur.	d., Bānda, 22-8-41.
HODGES	Inf.	1826	Sahāranpur, 1826-8; ch. Sundarbans., 1828-35.	resd., Dec. 1835.
HUTTON	Inf.	1838	Agra, March/April.	Served one month only.
LAWRENCE	Art.	1833	ch. N. Mrdbd., 1833; Frkbd., 1833-5; Grkpr., 1836-7; Allbd., 1838.	to mil. duty, Sept. 1838.
MACDONALD	Inf.	1828	Asst. Sahāranpur, 1828-8; Sahaswān, 1829-32.	to GTS. (367) 12-3-32.
MATHISON	Inf.	1838	in ch. Midnapore, 1838-44.	furl., Feb. 1844.
MAXWELL	Art.	1838	Asst. Agra, 1838-40; ch. Agra, 1840; ch. Ghāzipur 1841; Benares, 1841; Bihār, 1842-3; Sāran.	resd., 1844.
PHILLIPS	Art.	1836	ch. Tipperah, 1838-41.	furl. on mc., 18-2-41.
RIND	Inf.	1833	Sahāranpur, 1833-4; Muttra, 1835-6; Gorakhpur, 1836-8.	to mil. duty, Sept. 1888.
SHAKESPEAR	Art.	Jan. 1837	Asst. Gorakhpur, 1837-8.	to mil. duty, Sept. 1838
SHERWILL	Inf.	1838	Asst. Cawnpore, 1838-9; Leave to Cape, 1840-1; ch. Gaya, 1842-3; Rev. Svys., Lower Provs. 1844-54.	Prof. of Svy., Sibpur, 1856-61.
SIDDONS	Engrs.	1834	ch. Chittagong, 1834-40.	resd. Oct. 1840.
SIMMONDS	Inf.	1824	Asst., Delhi; ch. Delhi; 1829-33; Azamgarh (W), 1833-5.	to Clothing Bd., Feb. 1835.
SMYTH	Art.	1837	ch. Cuttack Central, 1837-43; furl., 1843-5; Lower Bengal, 1847-57.	resd., 1857.
STEPHEN	Inf.	1837	Grkpr., 1837-8; Allbd., 1838; ch. Ftpr., Hmrpr., 1839; Bānda, Benares, 1840-1; Gaya, 1841-8.	Rev. Svy., Punjab, 1846-51.
THUILLIER	Art.	1837	ch. Jaintia, 1837-40; Puri, 1840-1; Cāchār, 1841; Patna' 1842; Sylhet, 1842-4.	furl., 1844-6; DSG., 1849-61.
TROWER	Art.	1837	ch. Puri, 1837-9.	resd., Nov. 1839.
WROUGHTON	Inf.	1821	Grkpr., 1821-4; mil. duty, Arakan, 1824-6; ch. Grkpr., 1826-30; to mil. unit, 1830-2; ch. Muttra, 1833-5, Agra, central *doāb*, 1835-41; Mirzāpur, Narbada Terry., 1841-2.	mil. duty, Oct. 1842; DSG. Calcutta, 1844-7.

REVENUE SURVEYS : BOMBAY

Name	Birth & Death	Father	Corps Highest Rank	Survey Service
ANDERSON, Geo. Sligo. Alex.	b. 14-3-22 d. 19-9-85	James Anderson of Brechin co. Angus, merch.	Inf. Lt Gen.	Deccan, 1841, till after 1852.
ANDERSON, Wm. Coussmaker	b. 10-8-22 d. 3-1-93	Robt. Anderson, solicitor, of Hereford.	Inf. Gen. ; CSI.	Deccan, 1842 till after 1860, Svy. & Stlmt. Offr. Berār, 1870 ; Comnr. SMC 1877.
AYRTON, Frederick	Biog. Notes	..	..	..
BELLASIS, John Brownrigg	b. 12-8-06 d. 10-3-90	Geo. Hutchins Bellasis.	Inf. Hon. M Gen.	Deccan, 1837 ; mil. duty, 1839.
BOYÉ, Henry ...	b. 7-8-08 d., Marseilles, 16-3-73.	Lt.-Col. Wm. Boyé, Bo. Inf.	Inf. Hon. Lt Col.	Deccan, 1842 to mil. duty 1847.
DAVIDSON, David	Biog. Notes.			
DAY, Henry John	b. 30-1-19 d. 1872/7	Henry Traningham Day banker, Swaffam, Norfolk.	Inf. Bt. Col.	Nasik, 1843-8 ; mil. duty 1848-52 ; rev. svy. 1852-9 ; SO. Sind 1856-7 ; ret. 1872/7.
DIGGLE, Henry Wadham	b. 1809 d. 1841	Henry Wadham Diggle, BO. CS.	Inf.	Deccan, 1837-8.
EVANS, Wm. Edwyn	d. after 1888	John Evans, surgl. inst. maker, of Walthamstow.	Inf. Hon. Col.	Deccan, 1841 ; till after 1844.;
FENNING, Henry	b. 11-8-12 d., Dhārwār, 1-5-54, cholera.	Wm. Fenning.	Inf. Capt.	Deccan, 1839 ; mil. duty, 1840.
FORBES, John Geo.	b. 4-3-14. d., Bombay, 29-4-60.	John Forbes-Mitchell, of co. Aberdeen.	Inf. Capt.	Deccan, 1840-2.
FRANCIS, John Thos.	b. 16-2-19 d. 4-8-96	Benjamin Francis, of Guist, Norfolk.	Inf. Gen.	SMC. 1842 ; Deccan, 1850. Svy. & Stlmt. Comnr 1871-7.
GAISFORD, Thos.	Biog. Notes.			
LANDON, Samuel	b. 25-8-04 d. 9-9-90	Philip Landon, proctor, Cape Town.	Inf. Bt. Lt Col.	Deccan, 1839 ; mil. duty 1840 [245], Deccan 1841-8.
NASH, Alex. ...	Biog. Notes.			
PELLY, Henry Joseph	b. 9-1-18 d. 10-12-91	John Hinde Pelly, Bo. CS.	Inf. Gen.	Deccan, 1839 ; mil. duty. 1840.
ROBERTSON, Geo. Henry.	Biog. Notes.			
SCOTT, Edwin Luddington	living in 1889	Robt. Scott, of Oaklands, nr. Plymouth.	Inf. Hon. M Gen.	Deccan, 1841-53 ; 1852.
STATHER, Wm. Carlisle	b. WI., 4-1-08 d. 27-9-93	Hon. E. Stather, of Nevis I., WI.	Inf. Hon. Lt Col.	Deccan, 1839-47.
WELLS, Francis Chas.	bapt., 12-1-07 d. 18-5-90	Francis Bishop Wells, of Alexandria.	Inf. Hon. M Gen.	Deccan. 1837 ; mil. duty, 1842.
WINGATE, Geo. ...	Biog. Notes.			

CHAPTER XXII

CIVIL ASSISTANTS, G.T.S. & TOPO.

GREAT TRIGONOMETRICAL SURVEY ; *Sub-Assistants* — *Special Appointments*— TOPOGRAPHICAL SURVEYS ; *Madras* — *Bombay* — NOMINAL ROLLS.

IN 1830 the four assistants whom Everest had left in 1825 were employed on the longitudinal series that was nearing Calcutta. Olliver and Rossenrode were experienced surveyors who had served with Lambton from 1807 [II, 346 ; III, 491–2, 499]. Torrick and Peyton each had about seven years service. On the new work Everest did not expect much from any of them [351] ;

> I was to devise new methods, make myself proficient in them, and then instruct my subordinates in them. ... The old assistants were the last to be of use, and the most difficult to be instructed. ... Only...Mr. J. Peyton has ever become a proficient in the use of the new instruments and the new methods[1].

He asked permission to bring the whole party in to Calcutta for the rains of 1831 that they might bring up their computations under his immediate supervision, and be at hand for the measurement of the base-line [48–9] ;

> The period has now arrived at which it is usual for the establishment of the Great Trigonometrical Survey to take shelter against the severity of the rainy season, and as it will be a great public convenience that they should be as near my office as possible, I beg...that the whole establishment may...proceed...to Calcutta [352]. ...
>
> The salaries granted to the younger sub-assistants are not on a scale to meet the increased expence to which they will be subjected. ... The salary of each...is 140 rupees per month, from which must be deducted the cost and maintenance of a horse at 30 rupees at least, and of camp equipage and marching establishment at not less than 50 rupees. ...
>
> There is, therefore, a net balance of only 60 Rs. which is the pay usually granted to every ordinary draftsman, whose sole duty is that of attending at my office from 10 o'clock till 4. But the sub-assistants...are persons whose qualifications, together with the hardships they have undergone, mark them as...peculiarly deserving of...indulgence. ...
>
> Taking shelter during the rainy season does in no wise liberate...the Great Trigonometrical Survey from keeping up...marching establishment, and, therefore, there is no means of covering the charge of house-rent but by the net sum of 60 Rs. [331]. ...
>
> I have alluded to the case of the younger sub-assistants ; that of the elder ones is yet harder from their being family men.

Calling attention to the dearness of all articles of life at the Presidency, he asked that Olliver should be allowed Rs. 90 a month, Rossenrode Rs. 70, and Torrick and Peyton Rs. 50 each. This was allowed, except that Olliver was restricted to Rs. 70 as in 1825 [III, 353][2].

For eight survey parties [13], Everest estimated that he would want an establishment of — 1 Chief Civil Assistant — 5 Assistants 1st Class — 3 Assistants 2nd Class [371] — and 30 sub-assistants. He wanted these last schooled to

> a thorough acquaintance with, and facility of using logarithms, the common rules of arithmetic, vulgar and decimal fractions, the use of algebraic signs and symbols, so that they might apply the different formulæ...without fear of error—a knowledge of the fundamental rules of plain and spherical trigonometry, and practical geometry—a knowledge of the common methods of drawing plans—and writing a good legible hand, both as writers and draughtsmen.
>
> These are things which anybody can learn who is not incompetent of mind, but what are of more consequence than these are the habits of obedience and assiduity—the ability to bear toil and exposure to fatigue and climate—the disposition to regard their profession as their particular world and delight—without reluctance to devote themselves to a forest life—without a lingering wish to return to the society which they have forsaken[3].

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[1] Everest (9). [2] from SG. 1–6–31 ; DDn. 265 (198–200) ; BMC. 17–6–31 ; DDn. 263 (287–8). [3] DDn. 265 (261–91), 12–10–31, paras 78–9, 88–91 ; BMC. 4–6–32 ; DDn. 282 (68–9).

Olliver's appointment as Chief Civil Assistant on Rs. 600 a month, was duly sanctioned from 4th June 1832, with prospect of advancement up to Rs. 1,000[1].

As an immediate start Everest had to collect a team for the base-line measurement. He had already found a promising recruit in George Logan, recently arrived from England, who was brought into the computing office as substitute for Roos [340]. He borrowed Gunner Doyle from the Artillery, and

> Sergeant Murphy of the Building Department, ... in every respect a person far above what is ordinarily met with amongst the soldiery in this country. He is an excellent practical mechanic, a neat draftsman, and a man of some mathematical attainment ; ... he learns with facility, and is industrious, intelligent, and thoroughly free from the vice of inebriety. ...
>
> It will be necessary to erect several station towers for the trigonometrical operations, and... Sergeant Murphy will be exceedingly valuable from his practical knowledge of building[2].

Murphy was appointed sub-assistant from 14th February 1832, but not allowed to count previous service in the building department, nor to look for further military promotion.

W. N. James, one of Hodgson's recruits of 1821 [III. 263], was transferred from the Revenue Survey office, but for the rest Everest had to recruit the most likely local lads. By the end of 1832 he had recruited 14 apprentices, including the Bengali computer, Radhanath Sickdhar. Peyton had been transferred to the computing office as Deputy Computer, so that the authorized establishment of 20 sub-assistants comprised, in addition to Joseph Olliver, and in order of appointment[3],

Wm. Rossenrode
Murray Torrick
W. N. James
N. Kallonas
E. R. Boileau
J. W. Armstrong
Sergeant C. Murphy
A. Torrick
W. H. Forster
J. H. Scully
J. Thornton
R. Loane
Radhanath Sickdhar
R. C. Tulloh
F. Moran
R. Clarkson
C. R. Lane
H. Keelan
W. Martin, from Madras
Geo. Terry

The following terms of service were laid down ;

> Each person will be required...to serve for 3 years under pain of forfeiting one half of what he shall have actually received as pay [394].
>
> A Sub-Assistant on admission belongs to the 3rd Class, and will be entitled to a salary of 107 sa. rupees per mensem, made up of...Pay, 50—Tent Allowance, 40—Horse Allowance, 17.
>
> A Sub-Assistant who shall have served three entire years in the 3rd Class (provided there is no obvious charge of misconduct against him, and that he is able to pass an examination), shall be advanced to the 2nd Class, and be entitled to the monthly salary of 140 sa. Rs. —Pay, 64—Tent Allowance, including carriage, 46—Horse Allowance, 30.
>
> A Sub-Assistant who shall have served three entire years in the 2nd Class...shall be advanced to the 1st Class, and be entitled to a monthly salary of 173 sa. Rs. ...Pay, 93—Tent Allowance, including carriage, 50—Horse Allowance, 30. ...
>
> The Principal Sub-Assistant...receives a salary of 400 sa. rupees per month, viz., Pay, 295—Tent Allowance, including carriage, 75—Horse Allowance, 30.
>
> There are no fixed office hours for Sub-Assistants as for office clerks. They are constantly liable to be called upon at any time of the day or night when the duty of their station requires, ... but...every officer at the head of a party will refrain from calling unnecessarily upon his subordinates, or harrassing them, and it is a fixed principle of the Great Trigonometrical Survey that the Sub-Assistants are to be led to their duty by kindness [379]. ... But when ...merely the ordinary work of computation is to be executed, the office hours are from 10 in the morning till 4 in the afternoon.
>
> Any Sub-Assistant who shall have served with the Great Trigonometrical Survey to the satisfaction of his superiors for a period of 30 years shall be entitled to retire on a pension equal to the full net pay of the rank he may have held for the three years preceding[4].

During the rains and the latter half of 1832 these apprentices were trained in the computing office and out-of-doors by De Penning and Olliver, and by the end of the year had been distributed between the field parties.

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[1] CD to B. 10-4-33 (8-11) ; the post was left vacant on his retirement, 1842. [2] DDn. 283 (23-4) 1-2-32. [3] ib. (76-9), 18-5-32 & 266 (181), 5-6-32. [4] ib. (180-6), 19-10-32 ; sanctioned Mil. Dept. 329 of 22-8-33 ; GBO. comp. M/9-8 ; applicable to Madras est., BMC. 15-11-33.

Western who left for the Parasnāth series in March took Murray Torrick and Boileau, and was joined later by the younger Torrick and Thornton.

Macdonald took James and Scully to the Budhon series, whilst the Surveyor General brought him two more in February 1833, Loane, and Cropley who had replaced Moran.

Rossenrode on the Great Arc took Armstrong, Forster, and Tulloh, being warned by Everest to "take great care to instruct my young sub-assistants in their new duties, and assist them by your advice".

Waugh and Renny took Radhanath Siekdhar and Martin on their march to join Rossenrode, but in making up their Ranghir and Amua parties Waugh took Armstrong and Forster, whilst Renny chose Tulloh and Lane. They found

> Baboo Radanath Siedar...obedient and sober...but, ... while he possesses excellent principles and an active mind, ... he is so young and unformed in character that the constant stimuli of praise and success are required to ensure attention to the details of his duty. He is readily daunted by difficulties. ... We, however, conceive that with good and strict management his character will gradually form. ... As to his intelligence, readiness, and general capacity, ... he is very intelligent, quick, and zealous, and—when successful or excited by praise—regardless of personal labour and inconvenience. ...
>
> We have found Mr. Martin obedient and particularly sober and quiet in his conduct, but, being of a...dull and apathetic disposition, we cannot conscientiously state he is either trustworthy or industrious. ... Wanting...in zeal and aspiration, ... he can never rise to any eminence in a profession which demands both ability and devotion. He is, however, a good manager.
>
> This report is made with the knowledge of the individuals whom it affects[1].

The remaining apprentices worked under Everest and Wilcox on the Great Arc.

Various casualties occurred during the first two or three seasons—some dropped out—others were recruited. Murray Torrick and Boileau were discharged in April 1833 on reports from Western [59, 355] who, writes Everest,

> on account of ill-health, was obliged to remain at Bheerboom, and...directed...Mr. Torrick to carry on the work, ... and report...regularly every fortnight. Mr. Torrick appears not only to have neglected to make such report, but to have treated his superior with impertinence, and to have made the egregious and unpardonable blunder of fixing on two places as stations which were not visible from each other. ... This is not the first complaint I have had against Mr. Torrick from Lieut. Western. ...
>
> Mr. Boileau...is reported absent without leave. ... This is not a first offence[2].

The Surveyor General made his report, and Government issued their orders for immediate dismissal, all within seven weeks of Western's report, without the young men being given any opportunity for explanation[3]. Boileau, indeed, promptly put in a circumstantial account of having gone to Monghyr for medical attention after receiving verbal permission in reply to his written application. He afterwards did very well on revenue surveys [196–7, 399].

Macdonald was fortunate in having the services of James, who with no previous experience of triangulation in the field "set himself seriously and strenuously to work. ... and bids fair to be one of the most effective sub-assistants of the department". He was promoted from Rs. 200 to Rs. 300 a month. Scully also was a good worker. Macdonald had, however, "to report the death of that promising young man, Mr. E. Cropley, who died at Saugor...after a lingering illness, arising from a malignant disorder of the throat"[4]. His other assistant, Loane, had a bad report from Bridgman, on which Everest remarked that

> Mr. Loane has now been two years and two months in the department, and by this time he ought ...to have become competent to manage a small instrument in first rate style. It is grievous to think that he is now reported to be so rude in the handling as to render it unsafe to entrust one into his hands. ... Some of the young men...who entered after him are become very expert[5].

There was further trouble later—"letters which are termed impertinent by Lt. Bridgman"—and Loane resigned.

Waugh was more than satisfied with the work of Armstrong and Forster ;

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[1] DDn. 379 (12–4), 10–10–33. [2] from SG. to Mil. Dept., 13–3–33 ; DDn. 374 (16–7). [3] Everest learnt better later [376]. [4] DDn. 374 (114–7), 1–11–33. [5] DDn. 321 (259–60), 17–7–33.

> They are both zealous and fond of their profession, clever and full of resource on occasions of difficulty. Mr. Armstrong in particular is a very good computer, and from possessing the valuable quality of a good constitution can go through much fatigue and exposure[1].

The Great Arc parties at Dehra Dūn in 1834 included

J. Olliver Esq., and family
Mr. W. Rossenrode
Mr. C. Murphy and family
Mr. N. Kallonas
Mr. H. Keelan
Mr. R. Clarkson
Mr. G. Terry
Mr. W. Martin
Mr. C. K. Dove[2]
Baboo Radanath.

These had all been through the very strenuous months from November 1833, when Everest had forced his triangles across the difficult Jumna-Ganges plain [26–38]. He spared none of them, and it speaks highly for his leadership and personal magnetism that they all worked their very best in spite of a continued storm of heated letters, occasionally appreciative, but often ferociously angry [37].

To Dove, 11th March ;

> I thank you for your punctuality and attention to my orders. All your blue lights were seen and could not have been better managed.

To Keelan the same evening ;

> I have seen two of your blue lights, but only got an angle with one because your time was so irregular. ... I lost all your others, for the obvious reason that I was looking out for Mr. Dove's lights at Dholri. ... You are the cause of the detention of the camp by this neglect of my orders. The other day when I ordered you to commence at 4 you did not commence till past 5, and now when I ordered you to commence at 5 you begin half an hour before. ...
>
> If you had seen how punctually and regularly both Mr. Dove at Dholri, and Shekh Ahmed at Saroli, burned their lights, you would sink into the ground for shame, and, truly, it is most disgraceful that the Naik of my guard can do cleverly what one of the Sub-Assistants of the G.T. Survey is quite unequal to [412]. ...
>
> I send for your perusal a copy of a letter which I have writter to Mr. Dove. When shall I be able to write such a letter to you ? Yet Mr. Dove has not been 6 months in the G.T. Survey, and has no advantage over you, except that he is alert, and desirous to do his duty[3].

He scoffed at poor Keelan's admission that he had no watch ;

> No decent person is ever without a watch, and a man who has no watch can never pretend to be respectable. You ought to be ashamed to acknowledge that you have no watch. You might just as well say that you have no coat or no shoes or no hat. It is an essential part of the apparel, even of a stage coach driver[4].

again on 22nd ;

> You are evidently one of those uncertain people in whom no sort of confidence ever can be placed. Admonition and remonstrance are quite lost upon you, and it is plain that if you do not change your conduct, you never will be of the smallest use in this department.
>
> Ask yourself, of what use a person can be who commits blunders so often that when any business is entrusted to him he fails twice out of three times. This is precisely your case. Sometimes you are too lazy to get up in the morning. At other times you make intervals of 32 minutes instead of 16. At other times you break the pole. In short, you never succeed except by the merest chance.
>
> All this is very disgraceful to you, and I should certainly recommend you to look out for some other employment, for in the G.T. Survey you will never be of any use, and you only occupy the place of some more valuable person[5].

It was Dove's turn on 29th March ;

> It is manifest that the blue lights reached you in time, and might have been burned...if you had been resolute. ... You did not make the attempt, but gave it up at the first difficulty which presented itself. Why Sir, when you found yourself too faint-hearted to essay the steep hill by moonlight, which I would have done at your age for mere frolic, why did you not send for some one of the people who knew the road, and direct the man Dina to execute the task of burning the blue lights at the appointed hour ? Where there is a will there is a way, Mr. Dove, but it is my conviction that you preferred quietly going to bed at Hardwar. ...
>
> Nothing...will convince me that you have not grossly neglected my orders. ... Reflect how highly you were rated in my estimation before, and how much you have fallen.
>
> You say you will burn 4 blue lights the succeeding night. That will complete the mischief, ... for after having forced me to strike the scaffolding and leave Fodhua without obtain-

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[1] DDn. 372 (99–101), 23–8–34. [2] appd. *vice* Boileau [372]. [3] DDn. 321 (187–9). [4] ib. (188–9), 11–3–34. [5] ib. (202–3).

> ing my object, it would be consistent with...your present conduct to blaze away my best blue lights when no one was looking out for them, just as the stupid animal in the fable threw its heels into the mouth of the dying lion[1].

On a later occasion both Keelan and Dove were, as Everest puts it, "handed up to Government" for incompetence and put under stoppage of half pay, after which Everest reported that

> Mr. Keelan has not only shewn much contrition, but has conducted himself so much to my satisfaction, and attended so steadily to his duty, that I solicit permission to intercede for him. ...
>
> I am sorry, however, to say that I have fresh cause to complain of Mr. Dove. ... I left this young man on the 4th December in charge of the tower at Dehra, with orders to direct a heliotrope to this station where I am now observing. Although the distance is less than eight miles, he will not direct the heliotrope steadily, and I have been detained here 4 days. ...
>
> For so short a distance there is no possible excuse. ... I fear I must report Mr. Dove quite incorrigible and incapable. .. I have tried conciliatory measures with this young man ; I have reasoned with him in vain ; nothing but coercion will have any effect, and if this should fail I shall be under the painful necessity of recommending that he be dismissed.

A week later he had relented and sent more "satisfactory accounts of the conduct of Mr. Dove". To all these reports the Secretary of the Military Department patiently replied, supporting the Surveyor General in his frequent changes, but on a further report he ruled that

> the time of the Government cannot be taken up in reading lengthy correspondence on trivial matters which you are fully competent to decide upon yourself. Any instance of gross insubordination...requiring exemplary punishment, such as dismissal, ... Government will always be ready to take into consideration[2].

Keelan had a long and successful career in the survey, holding charge of various field parties for several years till he retired some thirty years later. Dove, on the other hand, soon gave up the struggle. He resigned in 1835, and in 1860 was Postmaster General of the N.W.P.

Other resignations included that of Forster, who left to take up a local commission under his father who held command of the Shekhāwati contingent, to which he later succeeded himself. Andrew Torrick, having been specially admitted without examination, was later called on to pass a test, but preferred to resign.

By 1835 the establishment was headed by Olliver as Chief Civil Assistant—Rossenrode as 1st principal sub-assistant—James as 2nd principal sub-assistant—with Murphy, Kallonas, Armstrong, Forster, and Tulloh as 2nd class sub-assistants. There remained eleven of the 3rd class, including James Mulheran who had started as writer [334]. Armstrong was promoted to 1st class later in the year.

The Surveyor General solemnly warned the apprentices against running into debt;

> Economy is a lesson which must be learned sooner or later by every person who intends to walk erect in the world ; ... the sooner therefore the habit of living within one's means is acquired the better. A person who gets into the habit of borrowing finds it excessively difficult to overcome that propensity ; ... the difficulty of further borrowing is augmented, and he resorts at last to mean tricks, dirty shifts, and dishonest expedients. ...
>
> He who habitually borrows is, in short, unsafe as a companion, and unworthy of trust as a public servant. ... The young men...were engaged with the full understanding that their salary was...to cover all the expences to which they were liable in the field[3].

In 1836 a special order was issued to prohibit borrowing money from the Indian followers. Though not in a position to lend from their humble pay, some of these belonged to money-lending castes, and were in a position to arrange loans[4].

When Thornton, a particularly promising assistant, resigned in 1836, the Surveyor General was indignant to find that he had left to take up a more advantageous post on the revenue survey of Chittagong [195–6], and asked Government to declare it

> inadmissable for any Sub-Assistant to resign for...employment in any other branch of the Survey Department... without in the first instance obtaining the sanction of the Surveyor General. ... The secession of Mr. Thornton takes place at a most untimely period of the year, one at which his services can be least spared[5].

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[1] DDn. 321 (214–5). [2] BMC. 15–1–34 ; DDn. 285 (162). [3] DDn. 321 (c–d), 29–3–35. [4] do. 26–3–36 ; DDn. 356. [5] DDn. 286 (386–7), 4–11–36.

Two years later the problem was raised again when seven of the eight Bengali computers left in a body to become Deputy Collectors, whilst Radhanath Sickdhar was only prevented from accepting a well-paid post as schoolmaster by means of a substantial increase of pay [340–2]. Everest appealed in vain for better pay and more attractive terms of service for his men ;

> My Sub-Assistants generally are beginning to look out for employment in other lines more lucrative and less arduous, and...they only need to be thoroughly known in order to be generally appreciated and solicited. ... When this spirit of secession comes, ... the Great Trigonometrical Survey cannot be carried on unless more favourable terms are held out. The propriety of meeting this certainly coming evil by the timely application of some adequate remedy is clear [377][1].

The following extracts from the letter-book of the South Parasnāth series tell of Boileau's relations with his assistants. Kallonas was to fill Thornton's place at the end of the rains of 1836. On his way down from Mussoorie he was given leave in Calcutta till 15th October, when he called on Boileau at "Benton's Hotel, Ramemoodee Gully". In May 1837 he was given "three months leave...without pay" to visit Agra on urgent private affairs and, writes Boileau,

> talks of resigning the service at the end of that time. Should he do so, and no other sub-assistant is sent to replace Mr. Thornton, I shall be left...by myself. I am...computing the principal triangles (about 20 in number, besides some scores of secondary triangles), but find it very unsatisfactory to do so without having anybody to check my calculations[2].

Kallonas did not desert, but a new assistant, Brown, was continually on the sick list, and according to the surgeon at Midnapore

> will never again be fit for hard work in the junguls. ... Mr. Kallonas [writes Boileau] has received very advantageous proposals for leaving the Parasnath series, and entering the Revenue Department, as Mr. Thornton did, but he has hitherto remained firm, even against an offer of Rs. 250 per mensom, hoping to rise gradually in the Trigonometrical Survey[3].

Ill-health leads to ruffled tempers. Boileau had to report Brown to the Surveyor General, enclosing a wad of unseemly correspondence which arose "because I happened to omit 'yours obediently' before the signature of a note on the back of an old sheet of computations", the note reading—"Mr. Brown. Please to check all these barometrical calculations, including the rejected sets".

The following year, when Kallonas was in charge of the party after Boileau had resigned, he had so acrimonious a dispute with Brown that the proceedings of the resulting committee of enquiry were submitted to the Governor General in Council[4]. Both Kallonas and Brown left the department soon after the Parasnāth series was closed down [60].

From early days the Survey Department tended to become a family affair, witness the Scott's—the Burke's—and the Summers' [III. 310–1, 386, 501]. De Penning recommended sons of both Olliver and Rossenrode ;

> Regarding Mr. Rossenrode's two sons, John and William, ... I sent for the lads from the parental academy, and put them through the usual course of examination prescribed for candidates for sub-assistantship on the G.T. Survey, and both the lads passed...tolerably well, and much to their credit. ... They are both promising lads, and will...make excellent surveyors, especially the elder boy. ... Mr. V. L. Roos...has taken some pains in examining the boys, and appears to be highly satisfied with them. ...
>
> Andrew Olliver, third son of Mr. Joseph Olliver, ... is very anxious to join his brothers in the field as a surveyor. ... He is a very shrewd and intelligent lad, of quick natural parts...I have not the least hesitation in recommending him[5].

Joseph and Thomas Olliver were apprenticed in September 1837, Andrew two years later. Charles came from revenue surveys in 1844. Joseph was killed by a fall from his horse on the 21st December 1839.

A horrible tragedy occurred in 1838, when Owen Mulheran was left in charge of the base-line apparatus at Kaliānpur during the rains, with no European company, and was overcome by a fit of religious mania,

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[1] DDn. 342 (113–4), 18–2–38. [2] DDn. 370 (20), Midnapore, 4–6–37. [3] ib. (38), 1–3–38. [4] DDn. 356, 13–8–39. [5] DDn. 304 (281), 26–6–38.

> under the influence of which he had successively burned off all his toes and several of his fingers in the slow fire of a candle, and crippled himself for active exertion for the remainder of his life, together with diverse other particulars of a similar or even more lamentable nature[1] [54-5].

The Surveyor General concluded that his trouble had been brought on by "domestic calamity, and doubtless increased by the solitary nature of the duties...for many months". He was brought before a medical board at Landour in September 1839, and his discharge was ordered. A year later Everest recommended his reinstatement, having delayed the discharge

> till a judgement could be formed of the effect which a detention at the headquarters and the...regular and quiet performance of his business, together with the cheerful society of his fellow sub-assistants...might have on his mind. ... Mr. Mulheran appears entirely recovered, and has...performed his duties in the most satisfactory manner.

The re-appointment was approved with the proviso that he was to be kept at headquarters. His improvement being maintained, he was in 1842 promoted to 1st class, and posted to the Budhon series, where he got into trouble with Murphy, who took exception to his lack of manners, and to an unpleasant habit of "coming to office immediately after the internal and external application of a quantity of brandy and salt". There were other complaints and, on Murphy's threat to report him, Mulheran said that he was

> prepared to give a full answer...when called upon by the Surveyor General, ... who is never willing to hear anything against any of his sub-assistants without making some kind of an enquiry into matters, or calling upon the accused party to make his defence [372 n.3][2].

The affair blew over. From 1843 to 1845 Mulheran was posted to Du Vernet's party in the hills, where in the hot weather of 1845 he "again began to suffer from the climate". In January 1846 he was sent to run a series of minor triangles along the Ganges, but after two months was overcome by the heat. After a long period of leave "to the hills north of Deyrah Dhoon" he was "struck off the establishment... on the 9th December 1848"[3].

As there were never sufficient trained military officers available, opportunity frequently occurred of placing an efficient sub-assistant in temporary charge of a party, and the Surveyor General recommended that

> any sub-assistant on the G.T. Survey who shall have...shewn himself capable to conduct the duties of a meridional series during the temporary absence of his superior, ...shall... receive a salary amounting to two hundred and fifty Company's rupees per mensem[4].

Whilst Armstrong and Murphy were amongst the earliest to hold such temporary charge, Logan and James were the first to be given parties of their own, the Chendwar and Gora series [59].

The continued wastage of trained staff through resignations, discharges, and death, caused much anxiety, and the original estimate of twenty sub-assistants had made no allowance for casualties. Four sub-assistants were needed "for each subordinate series, five for each party of the Great Arc, besides the Chief Civil Assistant and two principal sub-assistants, and one tenth of the whole supernumeraries", a total of thirty one [20]. Government did not accept this scale in full as they thought it would be difficult to dispose of this number "when the Great Trigonometrical Survey shall be completed"[5].

Everest's recommended William Rossenrode for pension in 1841 ;

> On my return from sick leave in 1830, I found Mr. Rossenrode still with the Department, and took occasion to employ him...on an approximate series for the Great Arc. ... This he accomplished as far as the Chambal in admirable style, and, in fact, his were the only operations of the season 1832-3 which did not end in failure [24].
>
> In former years Mr. Rossenrode used to assist me by reading one of the micrometers of the large theodolite, ... but since my return from England...his eyesight is...seriously impaired. He has in no instance flinched from his duty, and though incapacitated from active exertion, worn down by repeated attacks of sickness, and labouring under painful chronic complaints, he has still accompanied my camp whenever I went into the field.

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[1] SG. to Mil. Dept., 3-8-39 ; DDn. 344 (104), para 145.

[2] DDn. 372 (700), 23-10-42.

[3] CD. to FD., 10-7-50 ; DDn. 542 (101), SG. to Mil. Dept. 19-11-30.

[4] DDn. 342 (113), 7-2-38.

[5] DDn. 402 (57-81), SG. to Mil. Dept. para 91 ; BMC. 26-1-42.

> Mr. Rossenrode is no longer fit for the active duties of the profession. He cannot ride. Frequently for months together he cannot walk, and though he contrived to accompany my camp to Sironj last season, he was never once able to dispense with...[his palanquin]. ... Persons belonging to the G.T. Survey must be prepared for the worst sort of cross-country tracks, and he who cannot ride may...be pronounced an incumbrance.
>
> Taking therefore into consideration...his long...36 years...service, ... I...hope that the largest scale of pension...may be extended to him[1].

Government authorized that the saving effected by his retirement, Rs. 279-13-4, should be distributed to the two next seniors, James and Peyton, and Everest reported later that the resulting promotions "had been attended with the most beneficial effects on the general efficiency of the department[2]" [375].

The lure of better pay and prospects and an easier way of life drew away many a young assistant. In October 1843 Nicholas Parsick writes to James, to whose party he had been posted ;

> I have been offered a situation in the Collector's office here, but as I got my leave on condition that I should join your camp at Chunar, ... I could not think of accepting...without the Surveyor General's and your consent. I have...to be forgiven for not informing you... while I remained in your good camp. ...
>
> Because I have sold my camels and tent to Mr. Thomas Olliver, I trust you will not...think that I am determined to leave the Department with which I have been so familiarly associated since the last six pleasant years. My object was to get rid of a bad bargain. ... Every one of those animals is troubled with some complaint, and they are all old. ... So as an inducement I offered my tent to Tom for a 100 Rs. only. ... The tent has undoubtedly gone very cheap, but I am content, ... because had I brought the camels here, I should never have sold them for Rs. 330, and they would not have stood the trip...with the loads I have for them.
>
> I have written to the Colonel for his permission to leave the Survey. ... So long have I talked of resigning that I now go by the name of "General Croaker's eldest son". ... It was only lately Murphy retired, and I cannot flatter myself so far as to think that I am more useful than he was. I shall sincerely lament the loss of the abundant kindness I have invariably received, and I shall never forget the assistance you have...so cheerfully given me. ...
>
> The appointment I can get in the Collector's office is worth Rs. 175 per month, and as... the Head Assistant is about to leave, I have every prospect of promotion to Rs. 225. ... It will be nothing extraordinary if I find myself elevated to the grade of 3rd class Deputy Collector, on a salary of Rs. 300 per month. ... Situations are very scarce now-a-days, and if I lose the present opportunity, I know not when another may occur.
>
> I can be near all my relations, and at such a large station as Agra can enjoy all the charms of society, and the comforts of a settled life.
>
> Promotion is very slow in my own Department, and the remuneration is too small for the amount of labour expected from us. There are three subs between me and the first Rs. 260 man, and though...I shall have 260 after...two years, yet that cannot compare with the prospects...in the Collector's office. ...
>
> I have always been for to leave the survey, and shall always remain discontented with it, because I dislike a wandering life. I am of course liable to censure in wishing to resign at this season, ... but when is it that a Sub-Assistant is really not required ? From June to October he is engaged with the computations, and from October again to June he is out in the field. ... May I hope to be permitted by you to resign from the 1st proximo ?
>
> With regard to the Rs. 230 that I owe you, I do promise...to remit Rs. 40 regularly every month, commencing from...November. Do not accuse me of playing you a trick. I was not sure...at Dooban, otherwise I would have opened my mind to you at that place. Had I spoken prematurely, I might have been laughed at by...the whole Department[3].

Parsick was allowed to go, and made good in his new career.

Accounts of misbehaviour may be justified as throwing interesting light on the normal routine of survey work. Francis Boyne, who had been transferred from Madras in 1841, after proving "incompatible" with Campbell of the Salem survey [382], was now with Du Vernet in the Himālayas, and had just been promoted to the 1st class. Du Vernet faulted him for delay in starting out from Dehra Dūn ;

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[1] DDn. 402 (158), 12-6-41 ; DDn. 401 (51), 18-8-41 ; DO. 4-9-41. [2] ib. (298-368), 13-8-42 ; para 243 ; ib. (371-86), ; pension sanctioned from 1-8-41, 15-8-42 ; para 40. [3] DDn. 504 (7) ; Parsick to James ; Agra, 23-10-43.

> I ordered you to visit Newada Station. On Sunday you would not do so, and on Monday evening you went out to that station. You ought to have visited it on Monday morning, and returned in the evening. The whole of the work given to you is in an useless and unconnected state, as many angles are wanting. ... It appears to me that your duty is...a matter of little concern to you; that, having got...your 1,500 rupees back pay, you...design to go away leaving your work to be finished as it may. ...
>
> You have sold your horse, and...I shall allow you but a short time to procure a good serviceable horse, and in the event of your not doing so I shall address the Surveyor General that your horse-allowance may be retrenched. ...
>
> I have now been here 6 days daily expecting to see you, but you have not yet visited the station of Berhoni, and have no idea of joining me here as ordered. ...
>
> The contingent bills sent in by you are not in a state to be laid before me, much less before the Surveyor General. They are shamefully and carelessly written, and are not according to form. Each bill must be written on a separate sheet of foolscap paper, headed, carefully written, and signed by you[1].

Boyne had a great deal to say in reply;

> I never proceed out on survey on Sunday, but take that day to myself as a day of rest, for neither body or mind can bear continual toil, and both require a seventh day of rest to preserve them in health and vigour, and, there is nothing better adapted to ensure much work during the week than a due observance of the day of rest. It may justly be considered an invaluable boon...to the subordinates of the G.T. Survey.
>
> Though the work is in an unconnected state...I dissent from you as to its being "useless". With a very little labour it will be as useful, and in as connected a state as the nature of the instrument...will admit of. ...
>
> As to my "loitering" away my time in villages—"that I have no idea of joining you at Gundial H.S."—...and various other conjectures, ... I decline defending myself till...my accusers are brought forward. ...
>
> My reasons for disposing of my country pony was with a view to provide myself with a strong hill pony which is better for those mountains. ... The contingent bills were not intended either to be laid before you or the Surveyor General, but merely as a copy to be entered in the books, and to be properly prepared on my arrival at Ghundial[2].

Du Vernet passed the letters to the Surveyor General in no kindly mood;

> Mr. Boyne is of a very sullen disposition; I have known him sulk for three days. His habits are also most penurious. ... Mr. Boyne's father-in-law is an opulent shopkeepr at Bangalore, and is desirous he should enter his business, and Mr. Boyne tells me he has advantageous offers from Captain Green to join the Revenue Survey of Mysore[3]. ...
>
> Mr. Boyne was instructed how to make out his contingent bills. ... To the present time I have been unable to obtain the bills...to send to the Presidency Pay Master. ...
>
> Mr. Boyne has furnished an illustration of his Sunday non-working principle. He writes he has measured all the angles at the station except one. On Sunday last the morning was remarkably clear. For several hours I could see, across his station, the men directing the heliotrope at Dhoiwala station. Mr. Boyne took no advantage of the opportunity.

Boyne had worked keenly on several earlier Sundays assisting with computations, but that, writes Du Vernet, was before he gained his promotion[4].

The papers were passed right forward to the Governor General himself, who sent them back for the Surveyor General's personal decision;

> He has not read with satisfaction any part of the correspondence, and...requests Lieutenant Colonel Everest...to bear in mind that the animadversion of authority may be delivered in cautious and considerate language; that subordinates have feelings as well as their superiors, and that to the uncovenanted, as to the covenanted, servant, his office is equally valuable[5].

Boyne was then transferred to the Ranghir series, and the useful James Mulheran sent to Du Vernet in exchange.

In spite of the Governor General's generous sentiments, officers of the uncovenanted services were generally held to be of inferior clay. "It is not the practice" writes the Accountant General "to accept an acquittance receipt from an irresponsible officer in the uncovenanted service"[6].

When hard pressed to complete the several copies of his professional reports, the Surveyor General asked for authority to pay his sub-assistants for overtime;

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[1] DDn. 435 (69-72), 7-4-42. [2] ib. (73-7), 9-4-42. [3] M Gen. Chas. James Green (d, 1886), Mad. Engrs. 1823-60. [4] DDn. 435 (61-8), 16-4-42. [5] DDn. 401 (168-9), 10-6-42. [6] BRC. 2-1-43 (13).

> There is a vast deal of extra copying which requires good clear writing, analogous to what is called engrossing, and I cannot meet with persons for hire in this part of the country who will... afford me satisfaction [112]. ...
>
> My sub-assistants are quite equal to the task, ... but it is contrary to...the regulations... to harass them...(except when in the field or for subjects purely professional) out of office hours, i.e., before 10 a.m., or after 4 p.m. [371]. If...Government will...reward their extra labours with a reasonable present, the object will be attained, ... and the work executed more ably than in any other mode[1].

The reply was a curt refusal and the work was completed by the sub-assistants without special remuneration on the long boat journey down to Calcutta [112][2].

Whilst insisting on discipline and the highest standard of work and conduct, Everest took a paternal pride in his sub-assistants.

> Finer, better, materials wherewith to form an establishment for...surveying I do not think will be found in any country. ... I have...twenty sub-assistants, besides one chief civil assistant and two principal sub-assistants, under my orders, of whom about eighteen are East Indians trained entirely by myself ; two are natives (one a Bengali Brahmin, the other a native of Arcot) ; and the remaining three are Europeans, genuine importations from England and Ireland[3].
>
> I allow no distinction of religion, faith, or complexion, ... but it is my effort to leave a fair field to all, and show favour to none. All...exercise authority according to their seniority. ... There seems to be but one common feeling actuating every member of the Great Trigonometrical Survey of India, which is to gain the approbation of their superiors by meriting it. ...
>
> Such...are the elements of the...East Indians—hardy, honourable, active, enterprising, energetic, sober, and intelligent—possessed withal of constitutions suited to the climate, under...which the uninured European sinks and withers as a blighted leaf[4].

General Walker writes of these Indian-born assistant surveyors many years later ;

> The subordinate officers are, almost without exception, European or Eurasian civilians, who were born and educated in India, and entered the survey...after passing through an examination, more or less severe. ...
>
> Soldiers...have been largely employed in...the Ordnance Survey of Great Britain, ... but in this survey it has been found preferable to employ civilians who...have acquired a greater knowledge of the language and the manners and customs of the people of India than is generally to be met with among the soldiers of the European Army.
>
> The subordinate officers were for many years styled Sub-Assistants, but latterly they have been called Surveyors and Assistant Surveyors[5].

SPECIAL APPOINTMENTS

A few appointments to the headquarter offices fell outside the cadre sanctioned for the Great Trigonometrical Survey [371]. These included De Penning and Peyton as Chief and Deputy Computers, and George Logan to act for Rees in the observatory [338, 340].

De Penning had been Lambton's most trusted assistant, and served with him from the very start of his survey. He had resigned the year after Lambton's death, and found employment in the office of the Deputy Surveyor General at Madras [III, 439]. Summoned by Everest to organize a computing office at Calcutta, he arrived on 20th November 1831, being allowed salary Rs. 400 a month in addition to his Madras pension [338].

Without any official status as such, De Penning had to act as the Surveyor General's representative at Calcutta until Bedford took over duty as Deputy Surveyor General in October 1838. He resigned in November 1843, a month before Everest left India, and died in Calcutta sixteen months later.

John Peyton had joined at Hyderābād in 1823, and had worked with Everest for two years on the Great Arc, and then with Olliver on the Calcutta Longitudinal Series. Being appointed Deputy Computer from 18th January 1832, he accompanied the Surveyor General up country, and held charge of computations at the field office. From time to time he took an active share in field operations ;

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[1] DDn. 452 (30-6), 10-7-43. [2] Peyton, Radhanath Sickdhar, Lane, Keelan, Nicolson, Andrew Olliver ; DDn. 401 (286-91), 25-8-43. [3] Murphy & two Mulheran's. [4] Everest (99-101). [5] *GTS.* II (75).

> The duty of his station does not render it incumbent on the Deputy Computer to take the field except as part of the office establishment of the Surveyor General. He cannot, therefore, properly speaking, be called on to take part in observing angles, or aid in the field operations, yet Mr. Peyton has, ... without receiving any additional salary, most handsomely come forward to co-operate with me, and performed all the duties of a most...efficient assistant[1].

In 1841 Everest obtained for him the appointment as "2nd Principal Sub-Assistant and Deputy Computer", on salary Rs. 400 a month [377]. In 1844 he was promoted 1st Principal Sub-Assistant, and posted to the Calcutta Meridional Series, taking charge the following year. The post of Deputy Computer was then allowed to lapse.

George Logan came out to India about 1830, and was engaged from February 1831 on a three years contract at Rs. 150, half Rees's salary. He accompanied the Surveyor General's office up-country[2], where he made good in every branch of the work. On Rees's return from leave his retention was specially sanctioned ;

> Mr. Logan was a connection of my...talented Deputy, Captain Herbert, under whose orders and tuition I placed him when he first joined. ... He made considerable progress as an observer—became skilful in the use of instruments—and his progress as a computer was sufficiently respectable. When the base of verification was measured on the Barrackpore road, Mr. Logan was entrusted...with one of the microscopes and with the general charge of the apparatus, so that...he made himself eminently useful as a practical man in the field. ... He is one of the most careful persons I have ever seen about instruments[3].

On 3rd October 1836 Logan was transferred from "the Surveyor General's Department to the establishment of the Great Trigonometrical Survey as a 2nd Assistant", on the same footing as a military officer except that he had no military pay and allowances. He was never sub-assistant. A year later Everest asked for his advancement to 1st Assistant, being "capable of conducting a meridional series", repeating his recommendation six months later, but without success ;

> Excepting Lieuts. Waugh and Renny there is no person...whom I would more confidently trust with any part of the operations. ... He is a highly honorable and correct young man. ... He is forbearing, but at the same time decisive in his dealings with natives, and speaks their language well. He is a very able observer and ready computer. He manages large instruments as expertly, and has acquired a knowledge of their structure as thoroughly, as could be desired. .. His constitution is strong and his activity great. ...
>
> Little more than a twelve-month had elapsed between his official nomination to be 2nd Assistant and my recommendation for his advancement. ... The only rule...is...qualification to conduct a meridional series[4] [354].

He again pressed for this promotion in July 1839 ;

> Every day brings fresh proof of Mr. Logan's fitness for the situation. ... He has been engaged the whole of last season...between Sironj and Ellichpur assisting Lieut. Renny [42], ... and that officer bears the same testimony to the value of his services. ...
>
> It is so difficult to obtain persons at all equal to the accurate performance of the duties of the Trigonometrical Survey...that...it cannot be for the interest of my employers to reject the services of any person who is found to possess those requisites in the extent that Mr. Logan does. ... I ought...to have 8 officers, and I have in reality only three [356][5].

Government was still reluctant to admit an uncovenanted civilian to the same conditions as their covenanted officers, and would not promote him to 1st Assistant, though they raised his salary from 250 to rupees 400 a month[6]. In 1842, the Directors intervened ;

> Upwards of four years having now elapsed since Mr. Logan was reported "fit to...conduct a series of meridional observations", ... Mr. Logan's promotion to be a 1st Assistant should no longer be delayed, and we accordingly authorize its taking effect from the date of your receipt of this despatch[7].

Logan's promotion was dated 17th June 1842, and a few months later he assumed charge of the Chendwar Series [59 n.1].

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[1] DDn. 344 (108–84), 3–8–39. [2] drawing an extra 50% on his salary. [3] DDn. 286 (85), 10–10–33. [4] DDn. 342 (123–5), 28–3–38. [5] Waugh, Renny, Jones (sick); Jacob (Bombay); DDn. 344 (81–4), 1–7–39. [6] DDn. 343 (68), 12–7–39. [7] CD. to B. Mil., 27–4–42 (35).

Rees continued to hold charge of the observatory at the Surveyor General's office in Calcutta, a post that was not in any way connected with the G.T.S. He was for many years responsible for the daily time signals hoisted for the shipping on the river [114–5, 342].

TOPOGRAPHICAL SURVEYS : MADRAS

To maintain a flow of surveyors and draughtsmen Montgomerie had a class of twelve apprentices under training in Madras during 1830, half of them recruited from 1st July of that year [III, 377][1]. When the office of Deputy Surveyor General was closed down in 1833, field parties were brought up to strength, a few transfers made to Bengal, and some to the Chief Engineer and other officers in Madras. Two sub-assistants were sent to Ceylon from Ward's party.

Two experienced draughtsmen, Joseph and MacVicars, went to the Calcutta drawing office, and one apprentice, Martin, to the G.T.S. ; Everest offered, without success, to pay Thomas Hill [III, 385] Rs. 250 p.m. in addition to his pension if he would come round to Bengal ;

> I know in what high estimation he was held by the late Captain Garling, ... and...I am very desirous to introduce into my department the admirable topographical style for which that Presidency has been long celebrated [III, 94]. ... It does not follow because Mr. Hill is pensioned that there is not a great deal of good work in him[2].

The composition of the field parties in 1834 was as under ;

Trichinopoly, under Thorold Hill ; MacMahon, Howard, Parr, Boyne, Orrock, McCarthy.

Nellore, under Snell ; Barnett, Charles and John Summers, Snell junr., Chatalier.

Hyderabad, under Du Vernet, with Macpherson as assistant ; Chamarett, Long, Britain, Wm. Ignatio, Turnbull, Parlby, Daly, Leigh.

Chamarett, of nearly 30 years service, had tried to play the "old soldier" on Macpherson, who had found it necessary

> to assign some share of the...triangulation...to the sub-assistants. The senior of these entertains the opinion that it is entirely optional with him to afford, or to withhold, his services in this branch of the labour, and that in giving temporary aid in it heretofore he has simply conferred a personal favour upon theofficer in charge.

Everest was surprised ;

> Pray tell Mr. Chamarett that I had a better opinion of him, and I hope that I shall hear no more of such an absurd reluctance to do what he ought to conceive it a very high honour to be allowed to do. If I do hear anything further upon this subject, I shall order Mr. Chamarett round here to learn his duty under my Chief Civil Assistant, Mr. Olliver[3].

The young assistants were wild horsemen, and the military authorities in Secunderābād wrongly thought they were subject to military discipline ;

> The young men attached to the Survey Department make a practice of galloping their horses furiously about the streets of the cantonment, habited in a manner unbecoming their situation, and inconsistent with the respect due to the superiors they may meet. You will impress upon...the individuals in question the necessity of a more becoming behaviour. ...
>
> They must be made distinctly to understand that they are amenable to military law, and that a repetition...will subject them to be tried by court martial for *disobedience of orders*. ... You will submit to me a nominal roll of the Surveyors Assistant attached to your Department[4].

Morland had trouble in 1840, but Bedford could do little to help ;

> This is indeed very vexatious work and, what is worse, unless the Resident afford you aid, I see no present remedy save to manage these turbulent rogues in the best way you can. The Supreme Government will do nothing until a long reference to the Surveyor General is received. Now Colonel Everest has been busily employed with his astronomical observations at Seronj and ...he is never very prompt in replying to letters when in the field [248, 252, 344]. ...
>
> Nos. 18 and 19 of the revised rules of 1830 give rather more power than is enjoyed by our Revenue Surveyors, who are limited to 14 days fine, and though I can suspend an Assistant it is only pending reference, in serious cases, to higher authority [394].

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[1] MRIO. Misc., 15–0–34 ; Map of the Environs of Madras, from Svy. by appces. [2] Hill was now 47, and lived till 60 ; DDn. 286 (93–6), 14–10–33. [3] from Macpherson, 1–10–32 ; reply by SG., 16–10–32 ; DDn. 326 (55). [4] DDn. 328 (147–8), 3–5–34.

> I trust, however, these two Assistants may evince a little more zeal, or I would put them under stoppages at once, to shew them that duty is not to be trifled with[1].

He carried the matter to the Council at Fort William ;

> The want of power to punish subordinates for idleness or misconduct appears to be a serious omission. Revenue Surveyors have for the last 20 years nearly been empowered to fine to the extent of 14 days pay. It is not often enforced, but it acts most beneficially 'in terrorem', nor in that department could work ever have progressed properly without the rule. ... In the Revenue Survey Department every fine is of course represented, and confirmed by the Superintendent on due cause being shewn[2].

Everest pointed out, however, that the regulations for the civil establishment

> of the G.T. Survey, which were made applicable to sub-assistants of the Madras and Bombay Presidencies in 1833, invest no power in the officer conducting a survey to fine or punish his subordinates, all clauses of that tendency having been struck out by the express desire of my Lord W. Bentinck. A reference to Government is the only method to be pursued[3].

This does not mean that Morland was always in trouble with his surveyors ; on the contrary, he found them a useful lot ;

> Mr. Chamarott, the senior, ... is an excellent plane-table surveyor, and can conduct...a secondary triangulation. He is also a very good plan draftsman. From...his education he shows a deficiency in collecting and embodying...the statistical memoir. ... He is, however, an intelligent and zealous sub-assistant, and has always made himself eminently useful. ...
>
> The qualifications of Mr. Long, the 2nd Assistant, are much the same, ... though he is perhaps less intelligent. ... He has always exerted himself to the best of his ability, and is a steady and useful man. ...
>
> Mr. Turnbull is a good plane-table surveyor and mathematician, and promises well.
>
> Mr. Parlby is a good plane-table surveyor, and tolerable plan draughtsman.
>
> Mr. Ignatio is a particularly neat plan draughtsman, and good plane-table surveyor.
>
> Mr. Daly is a good plane-table surveyor, and tolerable plan draughtsman.
>
> Mr. Leigh is a good plane-table surveyor and plan draughtsman.
>
> The four junior assistants are at present under...instruction. ... Their present comparative inefficiency arises in a great measure from want of experience and practice[4].

In the Salem party Francis Boyne got into trouble and made direct appeal to the Surveyor General, who passed it on to Bedford at Calcutta ;

> The channel is irregular, and Mr. Boyne must be informed that all such appeals must be sent through his immediate superior. If the superior declines forwarding the appeal, or if after ample time...no notice is taken, ... then the subordinate may forward it himself. ...
>
> It appears to me that Captain Campbell and Mr. Boyne are incompatible, and must be separated. These references and accusations...take up a great deal of time, ... and when a superior and a subordinate cannot agree, the sooner they are separated the better. ...
>
> I have no objection to employ Mr. Boyne on trial at my head quarters, for I find persons of that class generally very docile and tractable, and indeed have met with no instance in parties under my immediate orders to the contrary. ... Mr. Boyne must join me at Sironj in November or December next[5].

Boyne was transferred to Du Vernet's party in the Himālaya, but was no more "compatible" with Du Vernet than with Campbell [377-8].

As the Nellore and Salem surveys came to a close, the military officers reverted to regimental duty, and the sub-assistants retained

> until all the field-work [was]...brought up, and the material sent to the office of the Surveyor General at Calcutta in a complete state. ... All public instruments...to be made over to the nearest arsenal, ... receipts in full to be taken, ... and the senior Sub-Assistant...responsible that all are correct and complete. ... When a survey is finally abolished, ... all sub-assistants to receive their net pay only, ... until absorbed into other departments, ... and to be available for employment whenever called on[6].

Barnett was allowed five months leave to visit the Presidency,

> and eventually to Vizagapatam, on his pay and allowances, with the exception of lascar's pay, ... on the grounds of...long, faithful, and arduous service of 34¾ years, and his not having had any kind of leave since 1833. ...
>
> Messrs. Claudius and Chatalier become entitled...to promotion to the 1st Class ; the former on the 1st April, and the latter on the 1st July 1843 ; and as they have been uniformly reported in favourable terms, their claims are deserving of consideration. ...

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[1] DDn. 389 (25-6), 4-2-40.
[2] ib. (24), 3-2-41.
[3] DDn. 401, 26-3-41.
[4] DDn. 343 (377-8), 2-11-40.
[5] DDn. 410 (171-3), 18-9-40.
[6] MMC. 25-10-42 ; 31-1-43 ; BMC. 23-9-42 ; 20-12-42 ; DDn. 401 (247).

> Believing it to be a very difficult matter to replace...the Madras plane-table surveyors, or to re-organize a similar body if required hereafter, I...suggest...attaching a few of these sub-assistants to the Trigonometrical Survey. ... The sub-assistants...are all draughtsmen, and if it be decided that they should not be employed in the field, they might be ordered to... the drawing department of the Surveyor General's office[1].
>
> The well trained and able Sub-Assistants of this survey...might be beneficially directed to those parts of the country of which our knowledge...is most required. Madras having been the cradle of the Trigonometrical and Topographical surveys of India has enjoyed advantages which have not fallen to the lot of Bengal and Bombay, and the survey of the former Presidency may now be considered to be drawing to a close[2].

Though Charles Summers, aged about 40, felt too old for field work, he was persuaded to stay on and gave good service as a field surveyor for many more... years.

> I was apprenticed on the 1st October 1821. ... Appointed to the survey in the Northern Circars on the 1st January 1827. Employed on the surveys of the Vizagapatam and Ganjam districts till March 1832, when ordered to...Nellore District; continued in that survey till 1836 [254-5 n.4].
>
> Thence ordered to Goomsoor during the campaign in 1836 and 1837, and...volunteered my services for the survey of the Khoond country, Goomsoor, under...Captain C. T. Hill, ... and was for...five years in active and laborious service in a pestilential climate, from which my constitution had become so much impaired by repeated attacks of sickness that...I was re-appointed to the Nellore survey in 1841.
>
> I am in a great measure incapacitated for active field duties as a surveyor. ... I earnestly solicit to be employed in any office, such as the Chief Engineer's or Quartermaster-General's at the Madras Presidency, in the capacity of a draftsman[3].

After the final maps of Nellore and Salem were submitted in 1844, the younger assistants of the former party were transferred to Ouchterlony's survey of the Nīlgiri Hills, whilst those of the latter joined Halpin in Ganjam [254].

BOMBAY

After 1830 Jopp employed his small staff of pupil surveyors and draughtsmen in the drawing office and on various scattered surveys [240-1]. The trained men of the old Deccan Survey were either with the trigonometrical survey under Shortrede, or had been distributed among other departments.

> The only person that remained was the draftsman, Mr. Forjett, with whose assistance I set about an examination of the maps and papers...[of] that survey [III, 171-2, 393 n.2]. ... I retained him, however, in my private service on the same duty until the 1st of this month, but as I could no longer afford Rs. 100 per mensem from my personal pay, and an opportunity of his obtaining employment elsewhere offered itself, I discharged him.
>
> This additional duty, therefore, ... has cost me upwards of two thousand rupees[4].

In 1833 Jopp's staff numbered about a dozen, the senior of whom was James Aikin [III, 386], who obtained a pension on the closing of the office, pleading, at the age of 45, that he had to support "a very large family of nine children", and was handicapped by "the rapidly growing dimness of my sight, attended by other infirmities of body"[5]. In spite of excellent qualifications and promise, more especially of Bertie and Hanson, the whole staff had to be discharged[6].

Shortrede's assistants, Fraser, Price, and Sanger, were transferred in 1834 to the G.T.S.; on Price's resignation at the end of 1836 to take up a post in the Revenue Survey [396], Joseph Da Costa, formerly a clerk on the old establishment, was posted in his place from 7th August 1837, and proved a great success.

A number of useful surveyors passed through the Engineer Institution at Bombay or Poona [III, 384], and found employment in various directions. Amongst these was William Spry, who was working for the Collector of Kaira in 1837, in succession to James Nock. Spry drew several of Giberne's maps of the Rewa Kāntha [240].

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[1] from SG. 13-1-44; DDn. 452 (70-3). [2] ib. (136), 2-5-44. [3] DDn. 386 (421-2), 4-11-42.
[4] DSG. to SG.; 29-9-32; DDn. 235 (35-9). [5] DDn. 285 (52-4), 11-1-34. [6] from Bo. Ch. Sec., 6-2-34.

NOMINAL ROLL, G.T.S.

Name	Birth & Death	Appointed	Employment	Domestic
ARMSTRONG, John Wm.	b. Jly. 1812	12–1–32	Gt. Arc, 1832–3 ; Ranghir, 1833–4 ; Gt. Arc, 1841–2 ; Karara, 1842–5.	m. before 1835 ; resd., 1864.
BOILEAU, Edw. Raymond	b. Calcutta, 23–1–13 ; d. Chittagong, 10–9–44. MI.	12–1–32	S. Prsnth., Feb. 1832 ; dism., 1833 ; dmn., SGO., Calcutta, 1833–4 ; Chittagong Rev. Svy., 1835 till death.	son of Simeon Henry & Josepha B., of Calcutta ; m. 1st., Chtgg., 27–2–37, Eliza Snell ; m. 2nd, Chtgg., 22–12–41, Sarah Louisa, dau. of Henry Randolph.
BOYNE, Francis	...	GTS. 1–7–41	from Madras Topo. [385] ; Hmlya. Conng., 1841–2 ; Ranghir, 1842–3 ; leave to Bangalore, 4–4–43.	m., Bangalore, 10–6–39, Jessie Elizabeth, dau. of James Hayes, opulent merch.
BROWN, James B.	...	14–10–36	from Hosp. appce. Landour. ; Gt. Arc. 1836–7 ; Prsnth., 1837–40 ; resd., 1840 ; pr. Depy. Collr.	
CAMPBELL, C. D.	...	...	Amua, 1838 till dism. 4–6–40.	
CLARKSON, Richd.	b. *c.* 30–4–17 bapt., Calcutta ; 10–1–19.	14–5–32	Gt. Arc, 1833–43 ; Maluncha, 1843–5 ; E. Coast, 1845–64 ; resd., 1864.	son of James Oram C. (1786–1848), Ben. Inf., & Jacintha, Malay ; m., Calcutta, 18–10–50, Mary Christians, dau. of J. R. Ross.
CROPLEY, Edw.	d. Saugor, 27–10–33, aged *c.* 21.	19–12–32	Budhon, 1832 till death.	father still in India, 1833.
DOVE, Chas. Kemp	...	12–6–33	Gt. Arc, 1833–6 ; Budhon, 1836 ; resd., 1836 ; Opium Dept., 1840–3 ; Magte. Hooghly, 1853 ; Dep. PMG., Calcutta, 1855 ; PMG. NWP., 1860.	m., Calcutta, 9–9–41, Charlotte Agnes Smith.
DRIBERG, John G.	...	9–11–35	wr., DDn. 1834–5 ; Gt. Arc, 1835–6 ; Budhon, 1836–8 ; resd., 1838 ; ordained ; joined SPG. mission.	with bro. Rev. C.E.D., Tollygunge ; pr. kin to J. G. D., indigo planter of Nāthpur, Purnea.
FORSTER, Wm. Robt.	b. Hānsi, 21–2–17 ; d. London, 16–5–89.	14–4–32	Ranghir, 1833–6 ; resd., 15–8–36 ; local comn., Shekhāwati Bn., Rājputāna ; Comdt., 1848. Capt. 1837 ; Maj. 1860 ; ret., 1865 ; mil. services, *Ubique* (234–6) ; Hodson, IV (565).	son of Col. Henry F. (1793–1862) of Skinner's Horse and Shekhāwati Bn., CB., *DIB.* ; m., Brlly., 20–6–39 ; Mary Owen Hearsey, pr. dau. of H. Y. H. [II, 404–5].
GLYNN, Wm.	b. April, 1821.	9–9–40 Mssri.	Budhon, 1840–2 ; Hmlya. Conng., 1843–4 ; Karara, 1844 ; resd., 31–8–46 ; Asst. Commr. Oudh, 1868.	m., 1842, Miss Donnelly, sis-in-law to O. Mulheran.
JAMES, Wm. Nix [III, 371]	b. Jan. 1805 bapt., Cawnpore, 25–1–11 ; d. Chunār, 14–6–44.	24–9–32	1821–32, with Rev. Svy. [371] ; Budhon, 1832–5 ; Gt. Arc, 1835–42 ; ch. Gora, 1842, till death.	son of Richd. James. (1785–1818), Ben. Inf. ; m., Calcutta 12–10–27, Mary Anne White, wid. ; father of W. R. N. & J. O. N. J., both of GTS.
JAMES, Wm. Richd. Nix.	b. Dec. 1827 ; d. 1876.	15–8–41	Gt. Arc, 1841–2 ; Hmlya. Conng., 1842–3 ; Gora, 1843–5 ; resd., 1854 ; Asst. Commr. Jhānsi, 1854–60.	son of W. N. J. (*sup*) ; m., Mssri., 5–7–52, Rosamond Helen, dau. of Frdk. Short.
JOHNSON, Clement	...	17–1–38 Saugor.	Gt. Arc, 1838 ; resd., Nov. 1838 ; Dep-Regr. Fin. Dept. ; Agra Bank.	
KALLONAS, Nicholas	...	2–12–31	Gt. Arc, 1833–6 ; S. Pārāsnāth, 1836–8 ; ch., 1839 ; resd., 1840.	m., Agra, 4–7–37, Ann dau. of Anthony John.
KEELAN, Henry	b. 19–9–17 ; d. Mussoorie, 11–5–87.	18–5–32	Gt. Arc, 1833–42 ; Gora, 1842–5 ; ch. various parties till resd. 1864.	son of Condr. Luke K., inv., Benares, 1843 ; pr. from Swords, co. Dublin ; m., DDn., 8–6–42, Catharine Marianne Kavanagh who d., DDn., 8–2–73, aged 47.
KIRWAN, David	b. 25–12–23.	16–9–40, Mssri.	Gt. Arc & Karara, 1840–5 ; resd., 1847 ; Supt. Indus Canals.	son of Condr. David K., PWD., and Jane his wife ; m., Benares, 26–9–48, Emma Evelina., dau. of Wm. Dolby.
LANE, Chas. Richd.	b. March 1818.	14–5–32	Amua, 1833–9 ; Karara, 1839–40 ; Gt. Arc, 1840–1 ; Ranghir, 1841–2 ; Calcutta Mrdl., 1843–7 ; ret. 3–10–71.	nat. son of C. R. W. L. (1786–1872), Ben. Inf., who m., 1st, 1829 ; bro. of Wm., Asst. Rev. Survr. [399].
LOANE, Richd.	...	7–5–32	Budhon, 1832–5 ; resd., 1–9–35.	
LOGAN, Geo.	*v.* Biographical Notes.			
MARTIN, Wm. [III, 385]	...	7–8–32.	from Madras Topo. ; Ganjam, 1830–2 ; Gt. Arc, 1833–4 ; resd., 23–6–43.	
MORAN, Francis	b. 1813/4.	14–3–32	resd., 1832 ; later Asst. Sec., Calcutta Bible Soc.	son of Thos. M., matross of Art., and Jane his wife ; m., 31–8–48, Amelia Harriet, dau. of T. S. Sheppard.
MULHERAN, James	b. in Wales ; *c.* April, 1817. d. Nirmul, Hdbd., 25–3–69.	Wr., 27–11–32 GTS. 19–4–34	SGO. Calcutta, DDn., 1832–4 ; Gt. Arc, 1834–6 ; Ranghir, 1836–42 ; Hmlya. Cong., 1842–4 ; Karara, 1844–7 ; NW. Hmlya., 1847–54 ; Hdbd., 1855 till death.	son of Owen M., who arrd. India before 1832 ; bro. to Owen (*inf.*) ; pr. kin to E.M., who arrd. Calcutta with wife, steerage from Mauritius, Feb. 1834, m., Margaret before 1847.
MULHERAN, Owen	b. Cape Town, *c.* 1818 ; d. before 1854.	8–1–36 Meerut	Gt. Arc, 1836–9 ; sick 1839–40 ; Budhon, 1840–2 ; Hmlya. Conng., 1843–5 ; resd., 9–12–48.	bro. to James [*sup*] ; m. Allbd., 29–9–45, Susannah Donnelly, whose sis. m. Wm. Glynn [*sup*].

Name	Birth & Death	Appointed	Employment	Domestic
MURPHY, Chas.	b., Dec., 1798.	14-2-32 Calcutta.	enl. Br. Army, 1821; to Bdg. Dpt., 1824; Sgt., 1826; attd. GTS. Sept. 1831; Gt. Arc, 1833-6; Amua, 1837-9; Budhon, 1839-43; resd. Aug. 1843. Writes from Agra, 1845, asking for sedentary post GTS.; 1855, NWP. Sectt. Agra; 1860, Simla; 1862, House owner, Sabâthu.	m., as widr., Ft. Wm., 15-6-29, Isabella Ross; his dau. Agnes Lingard m., 1888, C. H. West (1859-1923), Army Dept.
NICOLSON, James Ouchterlony	b. Feb./March. 1819; d. Upper Norwood, Surrey, 25-1-69.	GTS. 1-9-36	Oct. 1835, wr. SGO., DDn. Gt. Arc, 1836-40; Hmlya. Conng., 1841-3; Calcutta Merdl., 1843-50; ch. various GTS. parties, resd. 1864.	son of Capt. James N. (1788-1835); Ben. Inf., inv., 1832; James junr. m., Calcutta, 20-12-44, Elizabeth, dau. of W. A. Chalmers; she d. before May 1859.
OLLIVER, Andrew Cornelius	b. Hdbd., 24/30-4-22; d. DDn. 24-8-56; MI.	27-8-39 Mussoorie.	wr., Rev. Bd., 1837-9; Gt. Arc, 1839-42; Budhon, 1842-3; hd. writer, SGO., 11-11-44, till death.	son of Joseph [*inf*] m., Landour, 18-8-43, Emilia Billon.
OLLIVER, Joseph [III, 491-2]	b. Madras, 1785/6; d. before 1858.	13-3-1800	with Lambton's Svy. from 1804; GTS. from 1818; ch. Calcutta Longl., 1825-32; Gt. Arc, 1833 till ret., 1842.	father of Andrew, Joseph Thos. and Chas. O. of GTS.
OLLIVER, Joseph junr.	d. 21-12-39, from fall from horse.	22-9-37 Calcutta.	Gt. Arc.	son of Joseph [*sup*].
OLLIVER, Thos.	b. *c.* May, 1818; d. 15-4-78, aged 59y 10m 8d. MI., Karachi.	22-9-37 Calcutta.	Gt. Arc, 1838-43; Gora, 1843-7; resd., 1848, and joined Punjab Flotilla, Sukkur.	son of Joseph senr. (*sup*), m., Allbd., 28-9-46, Caroline, dau. of Robt. Cline.
PARSICK, Nicholas J.	b. *c.*, 1822.	31-10-37 Gwalior.	Gt. Arc, 1837-43; Gora, 1843; resd., 1843; Clerk Collr's. office Agra, 1844; Dep. Collr., 1860.	pr. kin to Petruse P., d., 1826 Agra, aged 43, alias Barsegh; Blunt 48/159; m., Agra, 27-12-47, Rosalind Maria Brown.
PEYTON, John	*v.* Biographical Notes.			
RADHANATH, SICKDHAR.	*v.* Biographical Notes.			
RAM DAYAL DE	...	9-9-40 Mussoorie.	Gt. Arc, 1840; Karara, 1841-2; Hmlya. Conng., 1843 till dism. 1844.	
ROSSENRODE, John Wm.	b. Aug./Sept. 1820.	4-1-39 Calcutta.	Gt. Arc, 1839-43; Chendwar, 1843-9; resd., Oct. 1852.	son of Wm. R. [*inf*].
ROSSENRODE, Wm. [III, 499]	b. Madras 1-3-1792; d. DDn. 9-9-52.	19-3-05 Madras.	Lambton's Svy., 1807-23; Gt. Arc, 1823-5; Calcutta Longl., 1825-32; Gt. Arc, 1833-41; ret., 31-7-41.	m., twice [III, 499]; father of John Wm. & Wm. Chas, of GTS.
ROSSENRODE, Wm. Chas.	b. Nov./Dec., 1821.	4-1-39 Calcutta	Ranghir, 1840-3; Maluncha, 1843-7; ret. 1876.	son of Wm. R. [*sup*].
SCULLY, John Henry	d. Allbd., 18-11-38.	14-4-32 Calcutta.	Budhon, 1833-6; Gt. Arc, 1836-7; Karara, 1837 till death.	
TERRY, Geo. Elisha	b. Jan. 1818.	9-11-32 Calcutta.	Gt. Arc, 1833-43; Chendwar, 1843-7; dism., April 1850.	1st. wife d., DDn., 13-4-42; 2nd wife, Julie Ann, d. Mussoorie, 17-6-49.
THORNTON, John [400].	...	1-5-32 Calcutta.	S. Prsnth., 1832-6; Shekhâwati Expn., 1834-5; resd., 1-10-36, to Rev. Svy.	
TORRICK, Andrew	...	21-3-32	S. Prsnth., 1832-5; resd., July 1835.	pr. son of Michael T., "Free Trader", Madras.
TORRICK, Murray [III, 386]	...	24-4-22 Hydbd.	Gt. Arc 1823-5; Calcutta Longl., 1825-32; S. Prsnth., 1832-3; dism., 18-4-33. Hd. Asst. Judge's Court, Cuttack, 1860.	eld. bro., to Andrew [*sup*]; dau. Isabella m., Cuttack, 1859, J. A. Wilson, Tlgphs.
TULLOH, Robt. Chapman	d., Edinburgh, 27-5-69.	14-5-32	Gt. Arc, 1833; Amua, 1833-5; resd., Aug. 1835; Exmnr., Pay Dept.	pr. kin to Capt. Robt. T., Ben. Art., who d., Calcutta, 1802, aged 38.

MADRAS TOPOGRAPHICAL SURVEYS

ALLEN, W. ...	...	19-3-35	Salem, 1838-42; Ganjam, 1843-6.	
BARNETT, Chas. Wm. [III, 384]	b. 1-3-1800; d. Madras, 20-7-68.	1-6-09 Madras.	N. Circârs, 1820-32; Nellore, 1833-42; Goomsur, 1836-7; ch. Nellore, 1842-3; ret., 1844, to Vizgptm.	m., 1-11-19, Mslptm., Leonora Hudson.
BRITAIN, Richd. Henry	b. *c.*, Feb. 1801 [III, 384].	19-4-23 Hdbd.	Hdbd., 1823-38; not shown in later rolls; pr. d. 1838 [256].	m., Madras, 3-9-23, Charlotte Chauner.
BOYNE, Francis [III, 384]	...	22-3-27	Mdra. & Trchply., 1830-2; Salem, 1833-41; to GTS. [384].	
BRUNTON, W. ...	...	1-7-30	Salem, 1835-9; abs. from 1-12-39.	
BUTFOY, Thos. Wm. [III, 384]	d., Berhampur 12-1-32, aged 21 y, 1m.	1827 Madras.	Ganjam, 1830 till death.	
CHAMARETT, Andrew [III, 385]	b., Jan. 1793; d., Poona, 18-12-48.	19-3-05 Madras.	Hdbd., 1830-48.	m., Scdbd., 3-10-20, Katharine Johaness; father of Andrew, junr., appce. 1852.
CHATALIER, Joseph	d., Ganjam, 28-11-52.	1-7-30	Nellore, 1833-43; Ganjam, 1843, till death.	
CLAUDIUS, Thos.	b. *c.* April 1816; d., Berhampur, 7-6-63.	1-7-30	Nellore, 1835-43; Nilgiri, 1844-5; Ganjam, 1846-54.	m., 1st, before 1845, Jane Eliza; m., 2nd, before 1856, Charlotte Amelia.
DAL (B)Y, Whitelaw III, 385].	...	1-4-27	Hdbd., 1830-42; ordered Ganjam, 1842, but did not join.	
HOWARD, Robt. 1,385]	d. before 1862.	22-3-37 Madras.	Mdra., 1830-2 Trchply., 1832-4; Salem, 1834-42; Goomsur, 1836-7; Ganjam, 1843 till resd. 1855.	wife d., Behrampur, Ganjam Jan. 1849.

Name	Birth & Death	Appointed	Employment	Domestic
IGNATIO, Colin [III, 385]	...	9–5–27	Hdbd., 1830–46 ; 'removed from Dept.', before 1849.	pr. son of C. A. I., Hd. Dmn. SGO., Madras [III, 316].
IGNATIO, Wm. [III, 385]	b., Nov. 1811 ; d. 30–12–33.	1–5–23	Hdbd., 1830 till death in fd.	pr. bro. to Colin ; m., Scdbd., 30–8–31, Margaret Hill.
KING, John Geo.	b. c., May 1816.	9–3–33	Nellore 1837–43 ; Ganjam, 1846–56 ; Orissa, 1859 ; ret. 1862.	father of W. King, appd. dmn. 1856.
LEIGH, John E. [III, 385]	b. c., June 1816.	14–4–27	Hdbd., 1830–43 ; Ganjam, 1843–54 ; Hdbd., 1859–60.	son of James ; and shewn as James in some list.
LONG, Richd. [II, 351 ; III, 385]	b. 27–7–1793 ; d. Scdbd., 7–10–55, MI.	27–4–05	Madras parties, 1810–21 ; Hdbd., 1821–5 ; ret., on pension, 1–9–47.	m., Trichur, 13–12–20 ; Ann Watts, half ? - sis. of C. R. MacMahon [*inf*] ; pr. father of R. H. L., appd. Hdbd. Svy., 1–7–45.
MACMAHON, Chas. Robt. [II, 351 ; III, 385]	b., Oct. 1791.	19–3–05	Madras parties, 1809–30 ; Madura & Trchply., 1830–4 ; Salem, 1834–44 ; ch. 1842–4 ; Nilgiri Hills 1844 till ret. 1855.	
MCCARTHY, Edw. [III, 385].	...	14–4–27	Mdra. & Trchply., 1830–2 ; Hdbd., 1832. Out by 1833.	
MENEAUD, Augustus [III, 386]	b., July 1807.	17–8–23	Madras Parties to 1833 ; break of service to June 1840 ; Salem, 1840–43 ; Nilgiri Hills, 1844–53 ; Calcutta DO., 1854–5.	son of Augustus M., arrd. Madras 1789 ; m., Matilda before 1832 ; sis., Eleanor Rosalie, m., Marcellus Burke [III, 384 ; IV, 345–6].
PARLBY, Chas. Henry [III, 386]	d., Hdbd., 5–1–73, aged 62.	9–3–27	Hdbd., 1830–43 ; Ganjam, 1845 but not 1846.	m., Scdbd., 9–7–36, Sarah Elizabeth O'Leary.
SNELL, Chas. junr.	d. in fd., 5–3–57.	...	Nellore, 1833–42 ; Ganjam & Orissa, 1843 till death.	pr. nat., son of Capt. Chas. Snell, Mad. Inf. [III, 504 .
SUMMERS, Chas. Augusus [III, 386]	b. c. Feb. 1808 ; d. 1860/2.	1–10–21	N. Circārs, 1827 ; Nellore, 1833–43 ; Goomsur, 1836–7 ; Ganjam, 1844–50 ; N.W. Hmlya., 1850–2.	son of James [III, 386]. wife Caroline Bubina, b. 10–4–33, d., Poona, 2–7–56.
SUMMERS, John [III, 386]	d. in fd., c., 1838.	20–5–25	Ganjam, 1829–33 ; Nellore, 1833–6 ; Goomsur, 1836 till death ; c. Map, MRIO., 133 (33).	bro., to Chas.
TURNBULL, Wm. Henry [III, 386]	d. in fd., Ganjam, 24–4–53, aged 42y. 7mo., bur. Cuttack.	27–3–27	Hdbd., 1830–50 ; Ganjam & Orissa, 1851, till death.	son of Thos. T. [III, 508] ; m., Scdbd., 14–5–33 ; Leonora Sarah Ficker, pr. dau. of F. R. F. [III, 385].

BOMBAY SURVEYS ; TRIG., TOPO., & REVENUE

AIKIN, James [III, 386]	b., c., Oct. 1789 ; d., Hdbd., Sind, 26–10–49.	...	Bombay Svys., from 1821 till ret., 10–2–34.	pr. father of Wm. ; wife Elizabeth d., Poona, 3–7–25.
AIKIN, Wm. [III, 386]	b. 1811/2.	...	SGO. Poona, 1828, till death, 20–3–34.	pr. son of James [*sup*].
BELL, Wm. H.	...	...	Deccan Rev. Svy., 1837–9 ; ret. before 1853.	m., before 1841.
BERTIE, Wm. [III, 386]	b. 1815/6.	...	SGO. Poona, 1828, till disch., 20–2–34.	
BUCKALL, Joseph A.	b. 1805/6	1–9–20	SGO. Poona ; to CE. 1833.	
BUTTERWORTH	...	26–6–38	Deccan Rev. Svy. ; possibly in Bhopāl, 1850.	
CANTRELL, Alex.	...	26–6–38	Deccan Rev. Svy., 1838/43.	
CRITCHELL, Edw. Richd.	b. England ; d. 10–9–71, Surat, aged 50.	26–6–38	Deccan Rev. Svy., from 1838; Post Office, Hdbd. Sind, 1846 ; Karachi, 1848 ; Gujarāt Rev. Svy., from 1854.	son of Edw. Richd. C. ; m. 1st., Poona, 15–9–43, Mary Beck Martinnant ; m., 2nd, Surat, as widr., Mary Ann Kelly ; gt. uncle of Hugh Martin C., S of I. 1919–55.
DA COSTA, Joseph [III, 386]	b. 1814/5.	1–9–28	SGO. Poona, Clerk, 1830 ; disch., 1834 ; Sub-Asst., GTS., 1837 till resd., 1863.	
FORJETT, F. [III, 393 n.2]	...	...	Dmn., S. Konkan, till 1830 ; SGO. Poona ; emp., privately by DSG. till 1832.	
FRASER, James [III, 386]	b. 1804/5 ; d. Poona, 15–12–63, MI.	1822	SGO. Poona ; appd. Sub-Asst., GTS., 6–2–34 ; ret. from Abu Mrdl., 1851.	m., Isabella before 1840.
HORNE, S. Edwin	b. 1815/6.	1–6–32	SGO. Poona ; disch., 1834 ; Bo Govt. Sect., 1843 ; Clerk, Comnr's. office, Karāchi, 1853.	pr. son of Francis [III, 386] ; wife Harriet d. 26–5–42, aged 25½ y.
NOCK, James (or John ?)	...	...	with Collr. Kaira till disch. 1834 ; with Leech to Afghānistān, 1837–8.	pr. son of Wm. N., Naval SK.'s office ; m., Broach, 29–3–29, Elizabeth Tucker.
PRICE, Wm. Samuel [III, 386]	b. Bombay, 1811/2	1–5–26	Deccan Svy., 1826–8 ; Trg. Svy., 1828–34 ; GTS., 1834–5 ; Deccan Rev. Svy., from 1837.	m., before 1840.
SANGER, Thos. B. [III, 387]	...	1–5–26	Deccan Svy., 1826–8 ; Trig. Svy., 1828–34 ; GTS., 6–2–34 ; Abu Merdl., 1855 ; resd., 1856.	
SPRINGER, John Hans [III, 387]	d. Poona, 20–2–61, aged 51y. 9mo.	1–5–23	Deccan Svy., 1823–30 ; SGO. Poona, 1830 ; till disch., 20–2–34.	widow Joanna, d., 1822.
SPRY, Wm.	...	...	with Collr. Kaira, 1834–42 ; with Giberne, 1837–8.	pr. kin to James Hume S., Surg., Bombay.

CHAPTER XXIII

CIVIL ASSISTANTS. REVENUE SURVEYS

Western Provinces — Lower Provinces & Assam — Bombay — Nominal Rolls.

IN 1834 there were four revenue survey parties working in the western districts of Sahaswān, Morādābād, Delhi, and Saharanpur, each under charge of a military officer, with a civil or military assistant surveyor, and several sub-assistants, draughtsmen and apprentices [III, [illegible] ; IV, 214]. The Gorakhpur survey had been closed down in 1830 [III, 152]. Establishments stood thus in 1834:

Sahaswan. Capt. J. Bedford, Revenue Surveyor;
Lieut. R. Macdonald, Assistant Surveyor.
J. Fitzpatrick and A. MacQueen, Sub-Assistant Surveyors.
J. Dumbleton and J. J. Rose, writers and draughtsmen.
G. Wyatt and P. Lucksted, apprentices.

Moradābād. Lieut. R. Browne, Revenue Surveyor
Mr. R. Terranneau, Assistant Surveyor.
A. Wyatt, G. Conyn, Sub-Assistant Surveyors.
E. & M. Sheills, writers and draughtsmen.
E. Jenkins, apprentice.

Delhi. Captain J. H. Simmonds, Revenue Surveyor;
Mr. J. Gould, Assistant Surveyor.
N. Hodges, J. Bridge, and W. R. Chill, Sub-Assistant Surveyors.
C. Bell, G. C. Chill, and W. F. Gore, apprentices.

Saharanpur. Captain W. Brown, Revenue Surveyor; Lieut. G. J. Fraser, and Mr. R. Nelson, Assistant Surveyors.
C. H. Burke, R. S. Chill, and C. C. Foy, Sub-Assistant Surveyors.
T. Sanderson and Wm. Davis, apprentices.

Brown had just lost one of his senior sub-assistants, David Chill, who had been dismissed for striking a villager. Three of the juniors were so indignant at the severity of the penalty that they struck work, protested in writing, and were themselves dismissed. They were reinstated two months later on expressing contrition. Chill was shortly afterwards engaged as draughtsman in the Calcutta drawing office [[illegible]5 n. [illegible]]. Though he had not been specifically debarred from re-employment, Government regretted that the Surveyor General "acquainted as you were with the fact of his dismissal should have given him employment, though of only a temporary nature ... without a previous reference for permission"[1].

Of the civilian Assistant Surveyors Bedford reports in 1832;

> I have personally known Mr. Terranneau for many years [III, 370, 507], and...he might advantageously...assume charge of a Survey either on an increased salary as "Assistant in Charge", or with the rank of Surveyor. ... Should promotion not to be deemed advisable, I would suggest that he assume charge of a combined survey in the northern division of Morādābād, ... on a salary of *st.* Rs. 400 per mensem in the field, and 250 during the rains.
>
> Mr. Nelson [III, 370, 489-90] has been eleven years in the...Department, and on his return to Calcutta after the Burmese war, was appointed to conduct a river and coast survey in Arracan, of which, however, circumstances prevented him from assuming charge [III, 137]. ... He would be better employed on a River or a Marine survey. ... His own views are directed to something of this kind, and...[I] recommend his transfer on the first opening. ... In the meanwhile he might assume charge of Lieut. Fraser's late survey [210]. ...
>
> The third uncovenanted Assistant Surveyor, Mr. J. Gould [III, 366, 371]. ... is differently situated from the above two...who were originally appointed Assistant Surveyors, whereas Mr. Gould was apprenticed as a draftsman, and has gradually risen to his present rank[2].

Simmonds later reported that Gould, "is the only person under my orders who is qualified for his situation as Assistant, but he has much to learn before he could act in an independent survey". He had, moreover, lost his physical energy and never rose to any responsible charge.

Terranneau was given an independent charge from 1834, but was not successful, and after two seasons had to revert to a subordinate position [230]; "he did not possess the mental vigour requisite to wield a large establishment "[1]. Nelson held charge of various detachments under William Brown [215] but was no longer young and vigorous, and was several times in trouble for passing bad work [230].

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[1] BMC., 21-6-33 ; DDn. 282 (260-1). [2] from DSG., 20-8-32 ; BRC., 20-5-33 (38).

Bedford continued to recommend that experienced civilian assistants should be given opportunities of holding executive charges :

> The question...involves a principle of no small importance in all its bearings, and if decided against the uncovenanted class, it cannot but generate much discontent, and completely destroy these hopes which the prescribed system of promotion from general ability and usefulness was calculated to create[2].

Of the assistants of this period Fitzpatrick, Wilson, Wyatt, and Pemberton, were the only ones to hold executive charges for any length of time.

Standard rates of pay at the beginning of 1833 stood at Rs. 250 for the Assistant Surveyors—Rs. 200 for the two senior Sub-Assistants—Rs. 150 for eleven others—Rs. 130 for two others—Rs. 102-13-0 for writers and draughtsmen—and Rs. 77-14-6 for the apprentices[3] [III, 365-6].

> Promotion in this hard-working and—with a few exceptions—deserving body of servants... must rest entirely on the indulgent...consideration of Government. ... The hope of moderate reward must have a beneficial effect. ... I ventured to recommend an advance of 50 rupees monthly to every sub-assistant who (after serving 5 years in the rank)...might...merit the indulgence. I further recommended a small increase of pay to the...draughtsmen, one of whom, Mr. Dumbleton, has a wife and family to support, and was strongly recommended by Captain Wroughton, to whose survey he was long attached.
>
> The claims of the apprentices rest on different grounds. They were all, or mostly, taken from the Upper Orphan School after a regular education for the Department, and with what was deemed a certain prospect...of the rank and pay of sub-assistant at the expiration of their apprenticeship [III, 365-6]. This hope has never yet been disappointed[4].

Promotions were sanctioned and in four cases pay was reduced. McQueen, indeed, was discharged after being reported for "incorrigible idleness, utter disregard of truth, ... inaccurate and slovenly performance of his duties and, above all, his drunkenness". He applied two years later for appointment to the G.T.S. but on Everest's request for a certificate of character he could not produce it,

> as it was...not favourable to my reputation in a private capacity. ... I was constrained to throw up my appointment in the Revenue Survey Department, the victim of passions arising from an over-conviviality in my habits. ... It is with a most pregnant feeling of humiliation that I make this frank and ingenuous confession, but, at the same time...[I trust that] this ...will operate in my favour as an earnest of that zeal, integrity, and assiduity, with which I am desirous to distinguish my future career under your immediate supervision[5].

Everest was unmoved ;

> Ingenuousness is more estimable than duplicity, no doubt, but does not of itself warrant my introducing amongst the youths of my Department a person who, by the force of example, might lead them into bad habits.
>
> A character for sobriety is easily lost but difficult to be regained, for drunkeness is a habit not to be shaken off by mere volition, any more than the rheumatism, the gout, or any other chronic disorder. I pity a man addicted to inebriety just as I should if he were subject to madness, but as I could not admit a person subject to the latter infirmity amongst my Sub-Assistants, ... I conceive myself precluded by the former[6].

Henry Lawrence, who was a prodigious worker himself, had to get rid of two difficult, idle, young men [222]. Fines of fifty rupees and formal reprimands having no effect, he asked for the dismissal of both Jenkins and Comyn. He had noticed Jenkins' temporary lapses of memory, and found him one day "between the hours of 12 and 1 o'clock...in bed, in a healthy state of intoxication". Comyn's behaviour was reported in some detail ;

> Mr. Comyn closed two villages on Saturday 30th ultimo, and owing to the state of the weather was not again called for field duty till midday 4th instant.
>
> At near ten o'clock on that morning, I stepped over to Mr. Comyn's tent, and asked him for his plans. He came out to me with the appearance of having just emerged from bed, and

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[1] SWP. Rev Bd., 11-7-37 (28). [2] from DSG., 1-9-34, BTC., 29-9-34 (94). [3] cf. rates for GTS. [371]. [4] from DSG., 10-6-33 : BTC., 2-9-33 (14). [5] DDn. 288 (460-1), 10-10-35. [6] DDn. 289 (292-3), 13-10-35.

> said that his traverses were not ready for plotting. On my observing that, exlusive of Sunday, he had had three whole days to do as many hours' work, he replied there was a mistake in the figures which he could not find out. I then took the calculations to my tent, looked over one of the villages, detected the error which indeed was in the first line, and after eating my breakfast took the work back to Mr. Comyn before he had finished his toilet. ...
>
> It was in consequence of the above specimen of Mr. Comyn's early hours and attention to his duty that I told him he must again attend office. ... I must now confess to you that I am weary of this person's presence, that he has been rather an impediment than an aid to me, and has, since the day he joined, given me more vexation and annoyance than the whole newly entertained establishment of mootsuddies[1].

In authorising these dismissals Government delegated such powers to the Revenue Board. Owing to the urgent demand for trained assistants both Jenkins and Comyn were re-admitted to another party a few months later.

In 1834, on the occasion of Patrick Chill's deputation to Arakan [107], William Davis declined to go as his assistant :

> I have no wish to quit my present situation. ... I was appointed...for...the Revenue Surveys within the Provinces, where...I am willing to do my duty. ... As Arrakan is a country that agrees with no man, I feel assured that I shall have no better chance than others, particularly as I do not possess a strong constitution. ... Were I to remain there for any length of time, the effects...would...entirely...incapacitate me from any active duty[2].

A volunteer was found to take his place, but Bedford asked for Government orders,

> to prevent future embarrassment. ... I am not aware of any such terms of apprenticeship as those referred to by Mr. Davis, and when many of the surveyors during the Burmese war were ordered to the Eastern Frontier, not only the uncovenanted assistants but...the natives (whose strong local attachments are well known) accompanied them [III, 333].

Government ruled "that Assistants in the Survey Department are not at liberty to refuse their services on professional duty within the British Provinces"[3].

Many of the assistants were of different mould, and most efficient and enterprising. In 1833 Nathaniel Hodges from Delhi was placed at the disposal of Claude Wade at Ludhiāna [273] for surveys on the western frontiers which included the course of the Sutlej and Panjnad rivers down to the Indus [219]. On the conclusion of this work Wade asked if he could be retained

> to complete the village surveys of the British reserved lands between the Sutlej and Jumna which were...commenced by Captain Simmonds [218]. ... The zeal and diligence with which Mr. Hodges has conducted his duties, and the...discretion which he evinced in the prosecution of his survey...among a rude and jealous people, who sometimes viewed his labours with suspicion, have frequently attracted my notice. ... Had he remained in the Delhi survey, he would probably now have risen to the grade of Assistant Surveyor, the allowance of which, viz., Rs. 250 per mensem, he was led...to expect...while attached to my mission[4].

Hodges was detained at Ludhiāna till 1836, when Government ordered his return to revenue surveys, where he had been "superseded by several of his juniors".

Bedford, as Deputy Surveyor General, kept a close control, partly by means of periodical reports, of the recruitment, posting, promotion, and transfer of all the assistants. The large increases of establishment which were made in 1833 and again in 1837 involved the recruitment of a number of inexperienced young assistants, mostly country-born "East Indians", with some "Europeans", either sons of British warrant officers, or young men recently arrived in the country on the look-out for work. He made it a practice to keep a number of lads working without pay in his drawing office at Allahābād [393–4]. After the dismissal of Lawrence's young men [*sup*], he asked Government for the appointment of

> William Blyth, the eldest of eight children who, with their mother, were left totally destitute by the sudden death of Mr. Conductor Blyth in July last. ... The boy has been attending my office for some time past, gained a good general knowledge of what he will have to do, and appears both docile and intelligent[5].

With a good training under Lawrence, young Blyth served the revenue surveys well for the next twenty years. Two of his brothers followed him into the Department.

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[1] from Lawrence, 5–12–33 ; BTC., 10–2–34 (35). [2] from Davis, 8–11–34 ; BRC., 31–12–34 (34–5). [3] BRC., 31–12–34 (35). [4] DDn. 353 (5–6), from PA. to Pol. Dept., 7–2–35. [5] from DSG., 12–12–33 BRC., 10–2–34 (35).

Amongst those educated in England were William Dodsworth, Francis Paye, James Pemberton, and Robert Shaw.

Dodsworth, aged 19 years, was a cousin of Nelson, "very respectable, well worth securing even on the salary of sub-assistant 2nd grade". His surveys in Hissār attracted the attention of the canal engineers, and Brown writes that

> Mr. Dodsworth, after joining me in the Bhuttee country from the Dehlee survey, which he conducted to my entire satisfaction, was immediately employed on the levels from the Guggur River to the Gharra [210]. During the operations Captain Baker of the Engineers, having examined his fieldbook, and tested his levels by connecting his own with them, expressed his approbation of the whole. ... They had crossed each other's work in three places at an interval of 20 miles. The coincidence had been most satisfactory[1].

Dodsworth was promoted Assistant Surveyor in October 1839 and, after the surveys had been closed down, was appointed to the Ganges canal. Cautley writing to him in December 1843 ;

> You are appointed Assistant Surveyor on 300 rupees a month under me. My office is on its way to Mynpoori and I shall be there on the 19th. I commence my line of levels from Mynpoori to Allahābād on the 20th. ... My object in applying for you was to get cross sections in advance. ... I must depend upon your doing your utmost to join me at an early day[2].

Dodsworth was still in the canal department in 1857 when he surveyed the ground occupied by the British forces besieging Delhi[3].

Of Paye, Bedford writes that he was

> an Englishman by birth, well-connected, and already known...to Government. Though never publicly attached to the Survey Department, ... [he is] a good draughtsman, and formerly assisted Lieut. Beauchamp when employed in Behar [III, 137]. The education of a gentleman in England, combined with respectable abilities, might render his services worthy of a higher rate of pay but (as in the case of Mr. Dodsworth) I propose in the first instance that his salary be limited to Rs. 100 a month[4].

Paye joined Terranneau for work in Azamgarh, and accompanied him to Bānda, taking over temporary charge in 1837 [227]. He was then nominated for charge of the survey of Dehra Dūn, but when that was allotted to Brown's party [220] he joined Lawrence in Allahābād in 1838 and nothing further is heard of him.

Pemberton, writes Bedford,

> is the son of a clergyman, and a school fellow of Lieut. Lawrence. From family misfortunes he entered His Majesty's service as a private, and was some time ago invited by Lieut. Lawrence from Bombay in the hope of obtaining for him...a more suitable provision. A salary of Rs. 50 only was at first proposed, but the nature of Lieut. Lawrence's present report on him induces me to believe that in proposing 100 per mensem, I am stopping far short of what Mr. Pemberton really merits[5].

Joining on Rs. 50 on 1st June, Pemberton rose rapidly and was promoted to be Assistant Surveyor three years later. He was transferred to Bihār with Stephen's party in 1842 [302], and from 1845 rose to an executive charge in the Lower Provinces which he held till his death in 1860.

Shaw, like Paye, had "received a liberal education in Europe" and was "nearly connected with officers of rank...in the civil and military services". He won praise from Lawrence after a few months "voluntary duty", and in October 1836 was posted to Brind's party in Azamgarh [215]. In handing over to Shaw on his call to military service in 1838, Brind expressed his appreciation of Shaw's "zeal and activity" and "his cheerful and valuable aid...to the survey operations"[6].

After transfer to Orissa, Shaw held charge of the Puri survey during season 1839-40 [186], and then started survey in Purnea. No work could be found for him when surveys were closed down at the end of 1842 and he was discharged with a gratuity of 4 months pay. He was living in Mysore nearly twenty-five years later.

Conductor Samuel Chill, who put four of his 13 sons into revenue survey, was promoted Deputy Commissary in 1818 and lieutenant in 1843, two years before his death at the age of 85[7] [III, 371].

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[1] DLR. 37/82 (22), 19-7-41. [2] ib. (189), 14-12-43. [3] MRIO., 183 (25). [4] from DSG. ; NWP. Rev. Bd., 21-10-34 (65). [5] ib. 7-10-36 (42). [6] from DSG., 10-5-36 ; ib., 17-5-36 (65) ; from Brind, Sept., 1838, BRC., 25-5-43 (57). [7] after his 2nd marriage in 1830.

David, the eldest son, was apprenticed from the Upper Orphan school in 1821, and posted to the Delhi survey two years later. He got into trouble, and after working three years in the Calcutta drawing office dropped out in 1835 [335 n.2, 387].

Patrick and William accompanied the Revenue Surveyor General to Fatehgarh in 1823 [III, 364], and were followed by the youngest brother George.

Patrick was Brown's most useful assistant, and during 1833-4 was holding charge of a *khasrah* survey camp in country that was

> arid and covered...by a vast expanse of sand, and where, independently of the frequent sandstorms that rage there, the atmosphere is incessantly impregnated with subtle particles of sand which throw an insufferable glare over the face of the country. ...
>
> On one occasion [he] met with an accident of breaking his thigh-bone in the execution of his duties, whilst personally supervising them in the evening, and twenty miles from his camp, ... having to pass over...ground close to the khadur on the banks of the Ganges, uncommonly fissured and indurated, and into one of which openings his right leg accidently got in whilst his attention was directed to the party surveying[1].

He made a good recovery though left with a slight limp, and towards the end of the year was given charge of an experimental survey in Akyab, where his whole detachment suffered severely from malaria [197]. He returned to Brown's survey and in 1841 took six months leave to Calcutta for treatment at the eye infirmary[2]. Being a good draughtsman, he asked, that as his right eye was "in a perfectly healthy state" he might help in the drawing office "to prevent my falling off into any idle habits foreign to the active nature of the employment of my station"[3].

When the surveys were closed down in October 1842, his petition for pension—service under 19 years—age under 35—was forwarded to the Directors[4].

His brother William tells of an unpleasant encounter with a military officer;

> I arrived at Agra on the evening of 18th June, and on the evening of 21st (Saturday), while I was on a visit to a friend in the military cantonments, ... an orderly sepahi[5] came to me with an oral message to follow him to the Brigade Major's office.
>
> Not being a military man, I did not attend to this oral summons, conceiving that if Capt. M. wished to see me he would have written to me. On Sunday (the day following) at about 11 a.m. the Brigade Major wrote to me to attend his office. ... I immediately went, ... but did not find him there. ... I went in search of him, and found him at a shop a little distance. ...
>
> I was received...with a volley of abusive epithets, such as "Impudent Fellow"; "Impertinent & Saucy Fellow". On my attempting several times to urge something apologetic of his charge of my disobeying his first summons, I was invariably stopped with "Hold your tongue"; "You are an impudent fellow"; "Do you dare to speak to me ?"
>
> On my asking (it was the Sabbath...) how long it was possible I should be retained in durance, he ordered some of his sepahis, with fixed bayonets, to sieze me, and rudely drag me into the street, which they did, and it was only after much expostulation and entreaty that I was allowed the use of my conveyance in going to the Brigade office.
>
> About half-an-hour after, the Brigade Major and Colonel Commandant themselves came there, when I was told that I must find bail for my appearance the day following at...the Assistant Magistrate's to answer a charge of assault brought against me. I was fortunately bailed by the gentleman who lived next door. On the following day I attended at Mr. D.'s catcherry, and was acquitted of the alleged assault.

He was directed to lay his complaint before the military commander[6].

William was promoted Assistant Surveyor in 1838, being mostly employed in directing *khasrah* operations [215]. On the closing of the surveys in 1842,

> I was then under Captain Abbott [227], and I was thrown out of employ with a number of other assistants. ... By the orders of the Sdr Board of Revenue, N.W.P., vacancies in other departments were to be filled up from the discharged surveyors. ... The Secretary gave me and another assistant writing and occasional map-making as a support [323]. ...
>
> I continued...till October 1844, when, surveyors being required in Scinde, I was constrained ...to go there as Assistant Surveyor on Rs. 250 p.m. ... In the latter end of 1846, ... finding it impossible...to get my family to Scinde, I resigned my appointment...for a sub-assistant's place @ Rs. 200 p.m. on Mr. Wyatt's survey in Tirhoot.

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[1] DLR. 37/82 (94), Memorial from P. S. Chill, 17-8-42.
[2] one-third salary forfeited on sick leave.
[3] DLR. 37/82 (35), 24-3-42.
[4] DLR. 37/82 (100), Aug. 1842 ; (127), 19-10-42.
[5] Indian private soldier.
[6] NWP. Rev.Bd., 25-7-34 (32-3).

He was re-appointed Assistant Surveyor in 1847, and in 1851, having trouble with his eyes, found a post with the Customs Department at Calcutta.

Nothing remarkable has been found about the survey career of the younger brother George. On the break up of the surveys he found employment with the Customs Department, and on his death in the Punjab at the age of 55 left landed property to the value of rupees 32,000.

Though the purchasing power of the rupee was vastly greater in those days, it must have been hard for these young East Indians and Europeans to keep themselves, even under camp conditions, starting with less than Rs. 100 a month, and with the doubtful expectation of reaching Rs. 250 on which to support wife and family. Promotion, moreover, did not always keep pace with merit, for the establishment charges of each survey party had to be kept strictly within a definite allotment [346-7]. The following is a list of those reached the honourable position of Assistant Revenue Surveyor.

Horatio Nelson	... Nov. 1821	John Dumbleton	... Feb. 1838
Robt. Terranneau	... March 1827	William Chill	... Feb. 1838
John Gould	... Dec. 1829	John Bridge	... Feb. 1838
John Fitzpatrick	... Oct. 1833	James Pemberton	... June 1838
Alex. Wyatt	... Oct. 1834	Charles Foy	... Nov. 1838
Francis Payo	... May 1836	Wm. Dodsworth	... Oct. 1839
Charlos Burke	... Oct. 1836	Nathl. Hodges	... 1842
Geo. Wyatt	... Feb. 1838	William Blyth	... Dec. 1843.

The following was the "double establishment" of the party working in Bānda under Stephen in 1840 ;

Lieut. Stephen, Revenue Surveyor, salary Rs, 526 ; contingencies, Rs. 200 — Lieut. Grant, Assistant Revenue Surveyor, Rs. 250 — both additional to military pay and allowances.

James Pemberton, Assistant Revenue Surveyor, Rs. 250 — Wm. Blyth, Senior Sub-Assistant, Rs. 200 — D. Blyth, Sub-Assistant, Rs. 90 — C. Bradley, Rs. 60 — G. Green and O. Higginbotham, @ Rs. 55, apprentices.

Indian establishment brought the pay abstract up to Rs. 2,984[1].

LOWER PROVINCES & ASSAM

Except for the distant control of the Board of Revenue at Calcutta, the various district revenue surveys in lower Bengal and Assam had no contact one with another until Bedford moved down to Calcutta and became Superintendent of Revenue Surveys, Lower Provinces [322-3]. Surveyors and assistants were picked up almost at random, and until 1838 formed no sort of corporate body or department.

Two surveys were in progress in 1830, one of the eastern Sundarbans under Alexander Hodges [192-4], and one of the Assam valley under Paulet Mathews [200]. The Assam survey had a Bengali and Assamese staff, and no military officer as was usual elsewhere. On Mathews' death in 1832, Christopher Hudson—not a surveyor but "very able as a draftsman"—was appointed from the Calcutta drawing office "as a temporary arrangement",

with a view to arranging and completing the surveys left unfinished by Mr. Mathews. ... The salary...has been fixed at Rs. 130 per mensem, with an allowance of Rs. 100 for travelling expenses, making in the aggregate Rs. 250 per mensem[2].

He made himself so useful that in 1838 he was appointed Deputy Collector, and the following year left the survey and was absorbed into the local civil service.

Two of the most useful assistants on the Chittagong survey, Thornton and Boileau, came from the G.T.S., and Thornton's enticement from the South Parasnāth series was deeply resented by Everest [374]. When Siddons re-organized his staff in 1838 Thornton was transferred to Upper Assam, where he eventually followed Hudson into the local civil service.

By the end of 1837 the Revenue Board at Fort William had started surveys in Monghyr, Sylhet, Tippera, and Orissa, and had difficulty in "finding individuals possessing a competent knowledge of land surveying, and of character and integrity to conduct such enquiries". They urged the formation of a special school of survey, and pointed out that, in spite of the permanent settlement [8],

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[1] DLR. 37-53 (5), 29-11-39. [2] B Pol. C., 29-10-32 (4).

> valuable estates are continually purchased at the sales for arrears of revenue...in which the definition of boundaries, and the ascertainment of the area and capabilities...become highly necessary to the protection of the rights of Government from fraud and usurpation [177-8].
>
> It would be...far too great an expense to depute a scientific surveyor from the convenanted service upon...such occasions, ... but...it would be hightly desirable to substitute a class of officers, moderately paid, and qualified both by character and education to conduct the surveys. ... If proper inducement was held out, a knowledge of Land Surveying would soon form part of the instruction bestowed...in the educational establishments in Calcutta[1].

The suggestion was passed to the new Committee of Survey [207-9], which

> recommended that a class of subordinate revenue surveyors should be constituted as a permanent order of public servants, with gradations and a fair prospect of promotion.
>
> Secondly.—That a school should be established at the expence of Government, ... & Thirdly, that a Superintendent of Revenue Surveys should be appointed, authorised to move from place to place and inspect the progress of surveying officers, to recommend for promotion, superintend the school, direct the exertions of the instructor, examine the pupils, & furnish them with certificates of qualification.

The Governor did not like the creation of "a class of public servants for whose services the demand must be...uncertain. ... As the survey of districts shall be completed, each establishment in its turn must be dissolved," leading to "a large number of unemployed officers".

> The Government had hoped that, as the surveys of the North Western Provinces have made considerable progress, ... some of the subordinate surveyors might...be available for employment in the Lower Provinces, but...the expectation must not be built upon. ... His Lordship will postpone, for the present, the...question of establishing a practical school for surveyors, & of appointing a Superintendent of Revenue Surveys[2] [186].

It was agreed however to start a register of surveyors, and five young men were nominated for training[3] and were distributed, one to Chittagong, and four to Orissa[4]. They were allowed travelling allowance at Rs. 15 a month in addition to salary Rs. 50. For Egerton's survey in Monghyr an older man, Page, was appointed on Rs. 100, which the Board considered moderate. Heysham, the only one of these to remain long, writes in 1844 ;

> Before entering the Department, I gave up my situation of 2nd assistant master at the Military Orphan school at Kidderpore [III, 300 n.4], where I was not only educated, but had many friends, which yielded me 100 Rs. per month. ...
>
> My promotion [being] refused solely on the ground that I had not been sufficiently long in the Department...convinced me that I had sacrificed substance for shadow, and (my former position how superlatively more comfortable than even my present one !)...damped my spirits. I was spoken to by my superior in language I thought I did not deserve. I answered him in a disrespectful tone, ... and received my discharge in April 1839. ... I was again appointed to the Cuttack survey about 5 months after my dismissal[5].

For the new surveys in Orissa, volunteers from the Western Provinces, Fitzpatrick, Shaw, Maitland Smith, and Charles Blaney, were brought down on increased salaries, Fitzpatrick being given charge of the Balasore survey and promoted full Revenue Surveyor in 1841 [365].

Though Bedford's move from Allahābād was at first intended as a temporary visit to advise on the new surveys, he remained to become the Superintendent that the Board of Revenue had asked for [322-3]. He writes shortly after arrival ;

> Nothing more materially conduces to good progress and economy than a full complement of well trained...native surveyors. ... The proposal made in Capt. Jenkins' letter...regarding lads from the Gauhatty school...strikes me as meriting attention. ... Were my own office in Calcutta, I would further propose a certain number of European...lads being prepared...under my assistant Mr. M. Burke, who draws an additional allowance as 'School Master' [346].
>
> In the North West Provinces, Office Assistants have thus generally been supplied to the different surveys by the sons of non-commissioned officers, who voluntarily attended for

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[1] BRC., 4-10-36 (15). [2] from Sec. to Govt., 2-5-37 ; BRC., 12-6-38 (63). [3] R to CD., Gen., 11-8-37 (16). [4] from Rev. Bd., LP. 26-10-37 ; BRC., 12-6-38 (92). [5] DLR. 37/49 (93), 17-8-44.

instruction, in the hope of filling occasional vacancies. ... They have been found to answer very well, and to be content with moderate remuneration [389][1].

Provision was made for regular engagements as in the trigonometrical survey. If discharge were claimed within the first twelve months all arrears of salary were to be forfeit. No resignation during the field season would be considered. The agreement was for three years, subject to refund of half the salary already drawn if earlier discharge should be demanded [371]. One rule reads ;

> To afford some check on the idle, inattentive, or contumaceous, ... every officer conducting a survey shall have power to fine any uncovenanted assistant for continual misbehaviour... not exceeding...14 days salary [381–2][2].

By October 1838 there were nine surveys in progress, for each of which four assistants were authorized and. reports the Board of Revenue,

> there are at present thirty-four employed, and Captain Bedford recommends...the appointment of his son, Mr. J. Bedford, as Assistant Revenue Surveyor on the usual salary of that grade, rupees 250 per mensem, and the restoration of Mr. W. Lane, who was dismissed from Captain Ellis' survey. ... He has suffered sufficiently for his fault[3].

The younger Bedford was in due course posted to charge of survey in lower Assam, where he did excellent work, and was absorbed into the local civil service [202–3].

There were accidents and occasional cases of misconduct. Siddons reports from Chittagong that c.w. Mullins[4] had,

> on the 11th December [1838], ... borrowed a native's gun to shoot with, which, bursting, cut his left hand severely between the fingers and thumb. I did not consider the wound dangerous, but as he was alarmed and I have heard of locked jaw ensuing from accidents in that part of the body I allowed him to take his own course of returning to the city, from whence he has not returned. ... Suggest he be put on half salary ; this appears to me a case when the surveyor was amusing himself instead of doing his work[5].

Shortly after his return Mullins again had his salary cut, being "laid up with inflammation in his foot brought on by a thorn whilst doing his duty". He was given work in the office and had "a little more than a fortnight's field work at the coolest season of the year". Receiving little sympathy from higher authority he resigned, and obtained an appointment in the Salt Department[6]. He was later appointed Surveyor in the Sundarbans [194].

River journeys by boat could be exceedingly tedious. Leaving Calcutta on 15th October, Kain and Pringle reached Sylhet on 22nd November,

> making our trip in a little more than 5 weeks. We came through the Sunderbunds, being the route generally taken by boats during this time of the year, immediately after the rains. We remained 2 days at Dacca, providing ourselves with provisions, whilst our baggage boat had made up to us, she having run aground one of the sandbanks in the Megna. We have had no other delay, excepting a very strong current against us more than half the way.
>
> In many places, from Narraingunge to this, we had no tracking ground[7], the river overflowing its banks, and consequently had to pull up against a current of 5 knots an hour[8].

On his return journey near Dacca, Pringle was

> overtaken by a storm on the 20th inst [March] in the river Kattanassa...where I lost one of my boats. ... Have been obliged to stay. ... I will be able to leave...by tomorrow evening, as I have another boat which an indigo planter has engaged for me[9].

After a journey down from Comilla, Michael was accused by merchants of Tippera of wantonly commandeering their boat. He explained that he had taken

> a baggage boat on 7th ult., not aware that boat had been engaged by merchants of Tipperah. Entirely empty. ... On my arrival at Dacca, some tradesmen of Comillah claimed the boat. The manji[10] was unwilling to return to Comillah, and agreed to carry my traps to Calcutta.

Mathison, from Midnapore, complained of his senior assistant, Aislabie ;

> On Thursday last, the 21st instant, it was intimated to the whole of my establishment that I should go into camp...6½ koss distant on the Monday morning following. ...
>
> Mr. Aislabie said he should be there on Monday afternoon, and was answered by me that I expected everyone in camp by 9 or 10 o'clock in the morning. Mr. A. immediately said

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[1] from DSG., 30–1–38 ; BRC., 13–3–38 (60). [2] DDn. 623, 18–4–38. [3] absence without leave ; B Rev. Bd., 16–10–38 ; BRC., 16–12–38 (39). [4] Chas. Wm., distinguished from Chas., pr. a cousin [399–400]. [5] DLR. 36/42 (162), 1–1–39. [6] ib. (194), 1–5–39. [7] for hauling boat by rope from the river bank [243]. [8] DLR. 36/7 (109), 23–11–41. [9] ib. 37/60 (96), 24–3–42. [10] boat-owner, DLR. 36/38 15/6–6–42 (56).

> "What, Sir, are we to travel on a Sunday"? I told him that the so doing was not at all necessary, and that it was surely no great hardship going in one march. But he replied that his horse was old, and could not go 13 miles, and added in an impertinent manner "I shall go back to Calcutta ; I am getting too old to be knocked about".
>
> He shortly afterwards...said, "Sir, I am going to Calcutta ; I shall send in my resignation when I arrive there". I told him...to put the matter in writing, and after repeating my wish that everyone should be in camp on the morning of Monday, I left the office room.
>
> After leaving the office, I enquired more particularly regarding the distance, and found that possibly it might prove to be nearer 18 than 13 miles. I accordingly sent for Mr. Aislabie, and told him that as the doubt did exist, the Assistants would have till Tuesday morning, ... and he replied that he could go on Monday, and rest his horse during the day half way.

Mathison then reproved Aislabie for having spoken rudely to him in the hearing of the whole office ;

> He replied that it was not intended against me, but...upon the quantity of work expected by Government. ... The work was really too much for him, and he thought he could better himself. ... I...reminded him that his leaving me without permission would involve the loss of his arrears of salary [394]. He replied that he had no fear on that head, as he had influential friends in Calcutta, and would get his salary. ...
>
> Sunday night, after all my baggage had gone off, ... an angle-book that Mr. A. had previously taken away...to make notes in the field was brought to me unaccompanied by any letter or message. Up to this day, Wednesday, Mr. Aislabie is absent from his duties without permission and, I believe, has started for Calcutta. ... I submit that Mr. Aislabie has forfeited all claim to his salary for the present month, and has virtually left the service.

Bedford was told that he had authority to discharge Aislabie in his capacity as Deputy Surveyor General[1].

Several of these assistants held charge of surveys before 1842 ;

Edmund Boileau	ch. of	Chittagong	1840–4
James Bedford	,,	Goalpara, Lower Assam	1840–2
John Fitzpatrick	,,	Balasore & Purnea	1838–41 ; 1842–4
John Kelso	,,	Cāchār	1841–2
Francis Morton	,,	Dibrugarh	1840–2
James O'Donel	,,	Purnea	1841–2
Robert Shaw	,,	Puri & Purnea	1839–40 ; 1841
John Thornton	,,	Upper Assam	1838–45
Wm. Wilson	,,	Tipperah	1840–2

Amongst the younger men Davey, Hoppner, and Wm. Lane did notable work later.

On the break up of the Gorakhpur survey in 1830 Wilson had passed to the Calcutta drawing office [III, 365, 372]. He returned to revenue survey early in 1833, and joined Egerton in Monghyr, accompanying him to Hijli in 1838. When Phillips took furlough from Tippera in 1840 and could recommend none of his own assistants for charge, Bedford recommended that

> Mr. Parker be removed to Midnapore, and Mr. Wilson (now at that station) proceed...to Dacca, and receive charge of the survey office from Lieut. Phillips. ... He is...a steady well-behaved man, and want of energy in the management of others is, perhaps, his chief defect ; but he is still able...to do what is reported to remain, either at Tipperah or Hijellee[2].

On the close of the Tippera survey in 1842, Wilson rejoined Mathison in Midnapore, taking over charge of that survey when Mathison took furlough in 1844.

By 1840 the nine surveys had been reduced to seven, and Bedford reported that instead of requiring further apprentices he would find it difficult to employ those already in service ;

> All have not of course turned out equally well, but the reports are, generally speaking, favourable, and those now attached...are qualified for every common duty, both in field and office. So far from requiring the aid of my school [393], my present embarrassment is how to provide for the supernumeraries caused by a reduction in the number of surveys[3].

By 1842 the retrenchments following the Afghān wars compelled the untimely closing of the revenue surveys, and Bedford was ordered to select the most efficient assistants for the few surveys that were to be kept on, and to put forward the remainder for discharge with gratuities. He proposed

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[1] from Mathison, 27–11–39 ; BRC., 16–1–40 (6). [2] from DSG., 29–9–40 ; B Rev. Bd., 14–10–40 (128).
[3] BRC., 27–10–40 (5).

that Mr. Fitzpatrick, ... after closing...at Balasore, ... assume charge of the Rajamal & Purneah survey from Mr. Senior Sub-Assistant O'Donel.

That from the 1st proximo Mr. W. A. Wilson be re-transferred to the Midnapore survey. ...

That another Sub-Assistant join the Patna survey, to complete it to the same strength as that of Behar when received from Humerpoor, vizt. eight assistants [302].

Respecting the other assistants now become supernumerary, or about to be so, by the reduction of the Dibroogurh, Tipperah, Sylhet, and Balasore parties, and those of the remaining Assam surveys if also stopped, ... the sudden abandonment of such extensive survey proceedings falls with peculiar hardship on the numerous uncovenanted servants. ...

Some of them were educated almost exclusively for the survey department—many have sacrificed their health...in the unhealthy jungles of Bengal—and all have the strong claim of arduous and incessant duties in the field season on a low scale of remuneration. ...

I...propose the following scale of donation, ... a small compensation for the sudden loss of a respectable livelihood, and of the fair prospects which every meritorious individual had of rising in the department. ...

To Assistants under 5 years standing,	...	3	months	salary
,, of 5, and under 7 years,	...	4	,,	,,
,, 7 ,, ,, 10 ,,	...	5	,,	,,
,, 10 years and upwards	...	6	,,	,,

The donation to those under 5 years standing may appear comparatively high, but...this sudden discharge falls on them with peculiar hardship, for almost every youth on first entering the department incurs an expense for tents and outfit of four or five hundred rupees, which... cannot be easily reimbursed. ... Supposing all the Bengal surveys to be stopped excepting those of Patna, Behar, Midnapore, and Purneah, the total approximate amount of donation on the proposed scale will be about 9,000 rupees[1].

Gratuities actually paid to 19 assistants totalled Rs. 7,760. Several good men were lost, such as Shaw and Kelso. Two found employment with the Great Trigonometrical Survey, Nield and Charles Olliver, whilst several others were readmitted when revenue surveys were restarted in the upper provinces in 1847.

REVENUE SURVEYS, BOMBAY

Pringle had carried out his experimental survey of the Deccan with a staff that was entirely Indian, and for his check survey later, Shortrede used without shame the European staff of his trigonometrical survey, which had from 1834 been transferred to the Great Trigonometrical Survey [235-6, 383]. It was not until 1837 that the revenue surveys of the Bombay Deccan were put under the able management of George Wingate, who had the immense task of raising of an entirely new department. He was given military officers for charge of definite areas, whilst detailed measurements and records were made by Indian measurers.

As personal assistant he was given William Bell, who had been through the Engineer Institution [III, 384] and drew salary Rs. 240 a month, with allowances for office tent, etc., of Rs. 75. After a time Bell and William Price from the G.T.S. were promoted Assistant Surveyors with the same status as the military assistants. For intermediate control it was proposed to recruit

East Indian lads...with an allowance of Rs. 25 per mensem each for their maintenance. ... After they had gone through the probationary period which should not exceed six to eight months, they might be brought on the regular establishment, and their allowances then gradually increased in proportion to their degree of proficiency, ... the maximum rate being fixed at Rs. 50 per mensem, with batta according to the established rules[2].

Government, on the 26th June 1838, sanctioned six lads...on an allowance to each of Rs. 25 per mensem, ... and Rs. 10 per mensem for a tattoo [370] while actually out in the district. ... One of these lads died, and another resigned about September 1840, and...the Superintendent... requested...Government to bring the remaining four...on the regular establishment[3].

Butterworth was promoted to Rs. 50, Critchell to 40, and Cantrell and Harrington to Rs. 30 each a month.

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[1] from DSG., 14-9-42; BRC., 10-10-42 (5). [2] BO RC. 110/1844 (179-82). [3] ib., 14-10-44.

Owing to continual changes amongst the military officers during the Afghān wars [367], Goldsmid, the civilian Superintendent, advocated getting special surveyors out from England. Davidson, on the other hand, urged

> the extended use of uncovenanted agency, as regimental officers are always liable to recall to their units. ... The superior class of Indo-Britons born and brought up in the country [are] inured to the climate, and well acquainted with the native languages, while their habits of living are sufficiently frugal to render them satisfied with a moderate salary[1] [370].

It was decided to persist with military officers, in spite of disadvantages, for "the survey and assessment...will never prosper so well as under the direction of European gentlemen selected from the Civil Service and the Army". To help out the regular staff, non-commissioned officers from the Sappers & Miners were attached to the survey from 1843 ; Sergeants Gooddine and Hexton as Assistant Overseers ; Corporal A. Whittam as Sub-Assistant Overseer.

NOMINAL ROLLS

CIVIL ASSISTANTS, BENGAL REVENUE SURVEYS

WESTERN PROVINCES

Name with Birth & Death	Appointed	Employment	Domestic
Anquetil, J. W. ... ed, Calcutta	May 1838	from volunteer Mnpri. to N. Mrdbd. till resd. same year.	nat. son of T. J. A. (1781–1842) ; Ben. Inf. [III, 122].
Ball, John	1–8–37	Grkpr. 1837–8.	
Bell, Chas. H. [III, 370] ... b. 1810/11	1–12–26	Delhi, 1827–33 ; Azmgrh. & Grkpr., 1833–8 ; Mnpri. & Gzpr., 1838–41 ; Bihār & LP., 1842, till resd. 1859.	son of G. B. B. (1780–1830) ; Ben. Inf.
Blaney, Chas. A.	1–11–35	Grkpr. 1835–8 ; to Orissa, 1838 [399].	
Blyth, Daniel Thos. ... kd. by mutineers, Jhānsi, 8–6–57	1–10–36	Grkpr. & Allbd., 1837–8 ; Bndlkd., 1839–41, Bihār, 1842–7.	son of Condr. John B. of Allbd. Mag., who d. there July 1833 ; m. Caroline before 1856.
Blyth, Wm. Edward ... b. c. June 1818	1–1–34	Frkbd., 1834–5 ; Grkpr. & Allbd., 1836–9 ; Bndlkd., 1839–41 ; Bihār, 1841–7 ; resd. 1855 to Punjab civ.	eld. bro. to Daniel (*sup*) ; m. 1st., Gzpr., 30–8–39, Charlotte Chamberlane ; m., 2nd., Amtsr., 28–11–57, Sarah Hunter, wid. dau. of M. O'Conner.
Bradley, Chas ... ... d., 1851/2	13–11–38	Allbd., 1838–39 ; Bndlkd., 1839–41 ; Bihār 1841–53.	m. Catherine before 1842.
Bridge, John [III, 370] ... b., 1808/9 d., Mymensingh, 1851	Oct. 1823	Delhi, 1826–33 ; Azmgrh. & Grkpr., 1833–8 ; Agra & Gzpr., 1839–42 ; Bihār, 1842–50.	m. before 1845.
Brown, J. A.	May 1835	Bareilly ; resd. Aug. 1835.	
Burke, Chas. Hyde [III, 312, 370] b. c., Aug. 1802.	20–12–21	from Madras 1818 ; Upper *doāb*, 1829–33 ; central *doāb*, 1833–41 ; Mrzpr., 1841 till ret. Chunār, 31–12–42 [313].	son of L. R. B., S.G.'s Regr. [II, 352].
Cawood, Wm. ... ... b. c., 1817/8 d., Mrdbd., 19–7–37.	Dec. 1834	disch. from Frkbd., 15–6–35.	
Chill, David Henry [III, 366, 371] b., 4–4–05	2–10–21	Upper *doāb*, 1829 till dism, June 1831 ; dmn., SGO., Calcutta, 1832 till resd. 1835.	one of 8 sons of Lt. & Commy Sam. Geo. C., who d. 15–7–45 aged 85 [390].
Chill, Geo. Constable [III, 371] d., Punjab 24–6–70, aged c. 55	1–12–26	Delhi, 1830–3 ; Muttra, 1833–5 ; Brlly., 1835–6 ; Mnpri. & Mrzpr., 1839 till disch. 1842 ; Customs ; Mrzpr., 1844 ; Punjab, 1854.	bro. to David (*sup*) ; m. Muttra, 19–6–36, Margaret Gale.
Chill, Pat. Spenser [III, 371]... bapt., Dinapore, 31–1–08	4–12–23	Upper *doāb*, 1829–34 ; Arakan, 1834–5 ; Grkpr. & Allbd., 1835–9 ; Bndlkd., 1839–41 ; Bihār, 1842 till ret., 1843.	bro. to David (*sup*).
Chill, Wm. Richd. [III, 371] ... b., 3–6–09	4–12–23	Delhi, 1831–3 ; Mnpri., 1833–4 ; *khasrah* svy., Mrdbd., 1835–8 ; Ftpr., 1838–9 ; Jhānsi, 1840–2 ; Rev. Bd. Allbd., 1842–4 ; re-emp., 1844 till resd. 1851.	bro. to David (*sup*) m., Mzfpr., 5–8–32, Indiana Clarke.
Comyn, Geo. [III, 371] ... b., 6–9–08 ; ed. England	4–12–23	Upper Provs., 1826 till dism., 10–2–34 ; dmn., PWD., Jblpr. ; re-emp. Rev. Svy., NWP., 1837 & Bihār till ret. 1846.	son of Lt.-Col. P. T. C. (1780–1832) ; Ben. Inf. who d. at sea, 4–4–32.
Daniell, Alex. ... .. b. India 1812–3 d., Calcutta, 19–4–55.	Oct. 1834	Central *doāb*, 1834–41 ; Mrzpr., 1841–2 ; Hd. Asst. DSG.'s office, Calcutta, 1844 till death.	pr. bro. to Matthew (*inf.*).
Daniell, Matthew ... bapt., Muttra, 31–7–16	Sept. 1835	Central *doāb*, 1835–41 ; Mrzpr., 1841–2 ; Punjab, 1854 ; Customs, Hānsi, 1856.	son of David D., trader, & Jane his wife ; m. Sara Ann.
Davis, Wm. [III, 371] ...	4–12–26	Upper *doāb* 1829–33 Frkbd. & Azmgr. 1833–7.	
De Silva	...	Brlly. & Grkpr , 1835–8.	
Dodsworth, Wm. Thompson ... ed., England d., Landour, 28–9–72 ; aged 57 ; MI, Blunt (77)	Sept. 1834	Upper *doāb* 1834–6 ; Delhi to Sikh Frontier, 1837–41 ; Bihār till tr. to Ganges Canal, 21–11–43 ; Map of Delhi, 1857, MRIO. 183 (25).	cousin to Horatio Nelson [III, 489–90] ; m. Rose before 1847, their dau. Charlotte m. W. T. Hunt, of Ganges Canal.

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[1] from Supt., Nasik Rev. Svy., 18–8–42.

Name with Birth & Death	Appointed	Employment	Domestic
DUMBLETON, John [III, 371] ... b., 23-9-04 d., Allbd., 19-9-54	1-5-18	Grkpr. 1827-30 ; Rohilkhand, 1831-7 ; to Excise Dept., Deccan Frontier.	son of Sgt. John D. of Lower Orphan Sch., Calcutta ; m., Angelina before 1832.
EAGLESOME, P. E.	Sept. 1837	Mnpri. & Mrdbd., 1837 till disch. 1838.	
FITZPATRICK, John [III, 363, 371]	...	v. Biographical Notes.	
FLEMING, John	...	Bānda, 1836 ; Brlly., 1837 till resd., 1-8-37 ; to Customs Delhi.	nat. son of James F. (1783-1830), Ben. Inf., who d., Delhi, 14-12-39
FOY, Chas. Christopher [III, 371] b., Delhi, 25-12-09	Jan. 1821	Upper *doāb*, 1829-37 ; Delhi, Hissār, Sikh Frontier, 1837-41 ; DDn., till disch. 1842 ; re-emp. Rhlkd. & Punjab. 1847-53.	son of Condt. Andrew F., of Delhi Mag. ; m., 1st Meerut, 23-8-30, Sarah Few ; m., 2nd, Meerut, 15-10-35, Cecilia Templeton.
GORE, Wm. Francis [III, 371] ... d., Mnghr., July 1846	Nov. 1826	Delhi, Azmgr., & Grkpr., 1831-8 ; Agra, 1840-1 ; Bihār, 1842 till death.	son of Dep. Commy.
GOULD, John [III, 366, 371] ... b., Madras, *c.* March 1800	3-12-13	Madras to Bengal, 1818 ; Delhi, 1822-33 ; Azmgr. & Grkpr., 1833-8 ; Mrdbd., 1838 till disch. 1842 ; pr. Customs cl., Agra, 1844.	son of Sgt. of HM. 59th Ft., kd. at Cornelis, Java, 1812 ; m. Delhi, 21-2-24, Charlotte, dau. of Wm. Staines.
GREEN, Geo.	1-10-38	Allbd., & Bndlkd. 1838-41 ; Bihār, 1842.	possibly Agent Govt. Stmrs., Benares, 1855.
GREEN, Wm.	...	Mrdbd. 1831-41.	
HIGGINBOTTOM, O. ...	1-11-37	Mnpri. 1838-9 ; Bndlkd. 1840-1 ; Bihār, 1842-3.	son of Sgt. Maj. of 65th BNI.
HILL, T. J.	Dec. 1834	Mrdbd. 1834-7 ; *v.* map MRIO. 17 (35).	
HODGES, Nathl. [III, 372] ... b. *c.*, March 1805	17-1-23	Delhi 1826-32 ; W. frontier with C. M. Wade, PA. Ludhiāna, 1832-6 ; Azmgr. & Grkpr. 1836-8 ; Agra & Mrzpr. 1838 disch. 1842 ; Sind 1844-50	son of Capt. A. Hodges ; Nathl. possibly Garden Overseer, Benares, 1860.
HUNT, T.	...	Gzpr. & Patna, 1841-2.	possibly Thos. Wm. H., who m., Charlotte, dau. of Wm. Dodsworth (397).
JENKINS, Edw. W. [III, 365, 372] b., Calcutta, 19-1-07 d., Mrdbd., Sept. 1837.	19-9-22	Mrdbd. 1830-3 ; Frkbd. 1833 till dism., 10-2-34 ; re-emp. Mrdbd. 1834 till death.	son of Wm. J.
LUCKSTEDT, Peter [III, 372] ...	1-12-26	Rohilkhand, 1827 till disch., March 1835.	pr. son of John L., Asst. Commy. who d., 1836, aged 61.
MCQUEEN, Alex. [III, 372] ... b. 12-1-05	2-10-21	Rhlkd., 1827 till dism. Aug. 1833 ; w.r. with Magte. Mzfrngr., 1833-4 ; re-emp. Srnpr., 1834 till resd. June 1835.	son of Sgt. Maj. Alex. McQ.
MCQUEEN, W.	1-11-34	Azmgr., *a* Rs. 100.	
PAYE, Francis Fredk. Ulric ... b. and ed., England	1-11-34	Asst. with Beauchamp, Bihār, 1828-9 [III, 137] ; Azmgr., 1834-6 ; Bānda & Allbd., 1836-8.	pr. bro. to Capt. John Richd. P., Nizām's Army ; m., Azmgr., 7-10-36, Alicia Jane Browne.
PEREIRA, F. S. P.	Oct. 1837	Azmgr., 1835-7.	Orphan son of "the Cameronians".
PEMBERTON, James Jeremiah ...	...	*v.* Biographical Notes.	
PERMIEN, Thos. Hanbury, son of Joachim Christopher P. who was b., Hamburg, Germany, and enl. Ben Art., 1795 and d. Agra.	Feb. 1835	Azmgr., 1835-8 ; Agra, 1839-40 ; Grkpr., 1841 ; Bihār, 1841-6 ; Punjab, 1847-52.	son of Asst. Commy. J. C. P. (1773-1841) ; 1st cous. to Daniel P., whose wid. Arabella m. J. J. Pemberton (*sup*) ; Thos. m. Mary before 1844.
ROSSE, John James [III, 372] ...	23-7-23	Rhlkd., 1829-32 ; Central *doāb*, 1833-40 ; Gzpr., 1841 ; Bihār 1842.	son of Lt. Qmr. of HM. 8th Dragoons.
SANDERSON, Thos. [III, 372] ... d., Srnpr., 7-9-34.	1-12-26	Upper *doāb*, 1829 till death.	
SAVIEL, A. ... ... d., Sept., 1837	10-2-34	Frkbd., 1834 ; Arkn., 1834-5 ; Grkpr., 1835-7.	
SCHENCKS, John Henry [III, 365, 372] b. 15-9-01.	31-1-18	Madras to Bengal, 1818 , resd., 1827 ; re-emp. Azmgr., 1834 till disch., 1837.	son of Sgt. on Madras Est.
SHIELLS, Edw. [III, 372] ... d., Calcutta, 20-4-37, aged 29	23-7-23	Mrdbd., 1827 till death.	son of Sgt. Maj. Michael S. of HM. 14th Ft. ; his dau. d. Calcutta, 10-5-32, aged 3.
SHIELLS, Michæl [III, 366, 372] b., 1811 ; d., 20-4-36	23-7-23	Mrdbd., 1827-34 ; Azmgr., 1834 till death.	bro. to Edw. (*sup*) son, Michæl Edw. d. Meerut 1833.
TRESHAM, David ... ... bapt., Agra, 12-5-14	Sept. 1835	Azmgr., 1835 till disch., Feb. 1837.	son of John & Rachel.
TUCKER, Wm. H.	June 1835	Frkbd., & Grkpr., 1835-8.	son of Condr.
WHEELER ... ... b. & ed., England.	June 1836	Bānda, 1836-8.	
WINSTON, Edw. [III, 372] ... b. *c.*, Aug. 1806	2-10-21	SGO. 1826-33 ; with DSG. Rev., Allbd., 1833-8 ; Calcutta, 1839-42.	son of John W. (1785-1808) Ben. Inf. ; m. Allbd., 2-11-37, Mary Lawler.
WRIGHT, Henry ... ... b. & ed., England	June 1836	Bānda, 1836-8 ; Agra & Mrzpr., 1838-9.	
WYATT, Alex. [III, 366, 372] ... b., Jan. 1807 d. at sea, 8-12-57	26-12-22	Rhlkd., 1827-38 ; Central *doāb*, 1838 till disch., 1842 ; with Benares Estate, 1842-3 ; Customs, Azmgr., 1843-4 ; re-emp. Rev. Svy., Sāran & Tirhut, 1844-50 ; ch. Mymensingh till death.	son of Dr. Geo. N. W., Ben. Med. who d. 1817 ; m. Sophia before 1856.
WYATT, Geo. Nevil [III, 372] ... b., 3-10-17 ; kd. Secrole, Benares, June, 1857	1-12-26	Rhlkd., 1829-38 ; Cawnpore, 1838 till resd. ; Dep. Collr. Bnrs., 1841-55.	bro. to Alex. (*sup*) ; m., Augusta Warren.

Name with Birth & Death	Appointed	Employment	Domestic
AISLABIE, W.	...	Mnghr., 1838-9 ; Mdnpr., 1839 till disch. Dec.	pr. kin to J. A., engr. of stmboats, Calcutta.
BABONAU, G. W.	...	Cttk. till disch., 31-1-43, with less than 5 y. service.	
BEDFORD, James	...	Senr. Asst. Mdnpr., 1836-40 ; ch. L. Assam, 1840 till disch. 1843 ; Asst. Commr., 1842 ; Dep. Collr. Assam, 1849.	nat. son of Jas. B., DSG. [202 n.6].
BLANEY, Arthur B.	Nov. 1838	Mdnpr. & Puri, 1838-41 ; U. Assam, 1842 till disch. Nov.	pr. son of Condr. Peter B. ; inv. Allbd., 1835, and kin to J. B. of Salt Dept.
BLANEY, Chas. A. [397]	1-11-35	Grkpr. 1835-8 ; Mdnpr. & Cuttack 1838 till disch. 1842 : drew plan Allbd. ch., MRIO. 17 (59).	eld. bro. to Arthur (*sup*) m., Chunār, 8-10-44, Mrs. M. Whiffen, wid.
BOILEAU Edw. Raymond b., Calcutta, 23-1-13 d., Chtgg., 10-9-44	3-11-34	dism. GTS. 1833 [384] ; dmn. SGO. 1833-4 ; Rev. Svy. Chttgg., 1834-9 ; in ch., 1840 till disch., 30-4-44.	m., 1st, 27-2-37 Eliza Snell ; m., 2nd, Sarah Louisa dau. of Henry Randolph, both at Chittagong.
BONTEIN, Wm. ed., Kidderpore Orphan Est. 1839-40	...	Balasore 1840 till disch., 1842.	pr. kin to James B. (1788-1828), Ben. Cav., and to his neph. John, ASG. [326-7].
BROWN, J.	...	Tppra. & Puri, 1837-9.	
BUTTERFIELD	...	L. Assam, 1841-2.	
CLEGHORN, J.	...	Mdnpr. & Blsr., 1839-40.	
CLEMENTS, J.	...	QMG.'s Dept. Saugor & Narbada Roads, 1832 ; Chtgg. Rev. Svy., 1836-8.	
CROW, Michael, senr. arrd. India, 1-12-40 d., 1846/7	...	Dep. Collr. Calcutta ; Svy. of Suburbs, 1841-6.	
CROW, Michael, junr.	...	survd. Calcutta suburbs under his father till disch., Feb. 1849.	son of above.
DAVEY, Nich. Thos. b. c., Nov. 1823	7-2-41	Mdnpr. & Lower Bengal, 1841-57 ; ch. Rev. Svy. parties from 1857.	
DENTY, James Henry	...	Cuttack, 1838-40 ; Monghyr, 1840 ; L. Assam, 1847 till dism. 1851.	
DYSON, J.	5-10-41	Cāchār, 1841.	
GUTHRIE, Chas. W.	Jan. 1837	Chtgg. & Tppra., 1837-41.	
HAYWARD, G. W.	Nov. 1838	Mdnpr., 1839-40 ; Tppra. & Chtgg., 1840 till disch., 28-10-43.	
HEYSHAM, Wm. b. *c.* March, 1821	Sept. 1837	ed. & Asst. Master at Upper Orphan Sch., Kidderpore ; Cttk. & Mdnpr., 1837-44 ; Saran, 1841-6 ; 24-Parg. from, 1850.	pr. son of Edm. H. (1787-1819), or of Wm. H. (1796-1825), both Ben. Inf.
HOPPNER, Edw. Wm.	Dec. 1835	Chtgg. & Blsr., 1835 ; till disch., 1842 ; re-emp. Sind & Rhlkd.	
HORNBY, Chas. St. John	...	Mnghr., 1837-8 ; Tipra, 1838 till disch., 1840.	
HUDSON, A. R. ed., England	...	Chtgg., 1837-8 ; Cheduba & Akyab, 1840 till resd., Dec. 1842.	pr. ygt. son of Nath. H., attorney, Calcutta, who had 3 sons, b. 1817/20.
HUDSON, Christopher K. [350]	Nov. 1832	from SGO. Calcutta ; ch. L. Assam, 1832-8 ; Dep. Collr. Assam, from 1838 ; later Asst. Comnr. Khāsi Hills.	pr. bro. to above.
HUDSON, N. J.	...	ch. Chebuda & Akyab, 1840 till resd., July 1842.	pr. bro. to above.
IVEY, Wm. b. *c.*, 1820/1	1837	Mdnpr. & Hooghly, 1837-47 ; Europe, 1847-9 ; re-emp., 1849 till resd., 1863.	inft. dau. d. Krishnagar, March, 1855.
KAIN, Thos. d. 1846/7	1-4-39	Puri & Sylhet, 1839 till disch., 1842 ; Mdnpr. & Hooghly, 1844 till death.	son of John K. ; m., Dacca, 27-8-42, Louisa Sinclair.
KELSO, John b. *c.*, 1803/4 d., Calcutta, before Aug., 1856	17-1-37	Bridge Dept., Alipore, from 1827 ; Sylhet Svy., 1837 till disch., 15-2-40 ; re-emp. Cāchār, 1-5-42 till disch., 1843 ; re-emp. 1847-53.	m., 1st., Calcutta, 5-10-27, Harriet Elviras Benjamin. m., 2nd., Eleanor, before 1841.
LANE, Wm. b. *c.*, 24-9-21	Feb. 1832	Bglpr., 1836 till dism., Feb. 1838 ; re-emp. Mdnpr., Oct. 1838 till abs. without leave to Europe Jan. to Dec. 1843 ; re-emp. Bihār, Punjab & Sind till ret., after 1870.	son of C. R. W. L. (1786-1872), Ben. Inf. ; bro. to C. R. L. of GTS. [384] ; m., Simla, 17-8-48, Sarah, dau. of Isaac Lemon.
McDORMAND, Augustine bapt., Calcutta, 7-7-22 ed., England	...	for U. Assam Svy. (tea), Oct. 1840, but tr. to L. Assam, 1841-2.	son of Thos. McD., HC. Mar., Hooghly Pilot, who left India, 1840.
MACGREGOR, E.	...	Cuttack, 1837.	
MASSONI, Louis (Lewis) d., Serampore, 15-6-45	1-11-38	Mdnpr. & Hooghly, 1838 till death.	
MICHAEL, Robt. b. *c.*., Feb., 1819	Nov. 1836	Tppra. & Chitgg., 1840 till disch., 1842.	nat. son of Thos. M. (1793-1829), Ben. Inf. ; m., Dacca, 15-11-41, Hannah Doucett.
MICHEL, Henry Louis b., Ft. Wm., 1-7-27	...	disch. from Glpra. Rev. Svy., 1842 ; cl., Gauhāti, 1849 ; translator to AGG., 1855.	son of Sgt. Henry M., Ord. Dept. ; m., Gauhāti, 5-12-49, Margaret dau. of Chas. Jones.
MOFFATT, James Wm.	...	U. Assam, 1841 ; Blsr. till disch., Nov., 1842.	son of Sgt. Jas. M., Ord. Dept.; Ft. Wm. ; m., Calcutta, 3-10-53 Louisa, dau. of H. Williamson.
MORTON, Francis Anthony	Dec. 1834	Chtgg. & Blsr., 1836-40 ; ch. U. Assam (tea), 1841 till disch., Dec. 1842.	
MULLINS, Chas. b. *c.*, 1809/10 bapt. Calcutta, 16-6-11	1-11-33	Chtgg. & Cttk., 1836-41 ; Purnea & Rjshi., 1845-56.	son of Chas. M. ; and pr. cous. to C. W. M. (*inf.*).

Name with Birth & Death	Appointed	Employment	Domestic
Mullins, Chas. Wm. ...	Nov. 1834	Chtgg., Puri & Sylhet, 1836 till resd., 1840; Salt Dept., 1844; Survr., Sundarbans, to 1852.	m., 1st, Chtgg., 29-11-38, Margaret Brown; m. 2nd, 8-1-41, Calcutta, Elizabeth Kerr; m., 3rd, Calcutta, 26-10-43, Primrose Sheppard, sis-in-law of Francis Moran [384].
Nield, Chas. Bridgman ... b. *c.*, 1-2-21	March 1838	Blsr. & Tppra., 1838 till disch., Dec. 1842; GTS., 1844 till dism., 12-12-50.	1854, PWD., Arakan.
Nind, John (James ?) ... b. *c.*, May, 1823	Nov. 1841	ed. Kdrpr.; Cāchār, 1841 till disch., Dec. 1842.	
O'Donel, James Hugh ... b. *c.*, Dec. 1819 d., nr. Nowgong, Assam, 22-4-72	16-12-36	Cuttack & Mdnpr., 1836-41; Purnea & N. Bengal, 1841-53; ch. various svys. till death.	nat. son of Hugh O'D. (1785-1837), Ben. Inf.; m., Bglpr., 11-7-44, Charlotte, dau. of Geo. Buckland.
Otto, Geo. A. ... ... b. *c.*, 1826/7 d., Calcutta, 17-8-48.	18-3-41	Mdnpr. & Hooghly till death.	
Owen, Wm. Louis ...	Oct. 1836	Chtgg. & Cttk., 1836-8; Mnghr., 1839; Tppra. & Chtgg., 1840 till disch., 1842.	pr. son of Arthur O. [1782-1824], Ben. Inf.; and his wife, sis. of H. Y. Hearsey [II, 404] and thus bro. to John, who d. Moulmein, 25-7-53; m., Chtgg. 24-12-41, Hannah, dau. of J. C. Fink.
Page, H.	1-10-37	Monghr., 1837 till resd. Feb. 1838 for appt. Customs.	
Parker, John A. ... ... b., 29-10-01 d., Bglpr., 15-12-53	Sept. 1819	E. Bengal, 1832 (map of Sandwip, MRIO, Misc., 12 (i) 39); till dism., Dec. 1840; re-emp., 9-10-44 as dmn. "of a high order"; Bglpr., 1848-50.	son of Wm. P., m., Agra 12-9-21, Catharine Manual.
Phillips, Anthony... ... b. *c.*, May 1824	Oct. 1841	Bihār 1841-4; resd., 1858.	son of Robt. Howell P.; m., Calcutta, 5-5-51, Delphine, dau. of Patrick Dudrenee.
Phillips, S.	1841	Blsr., 1841 till disch., 1842; from 1843 to '47 with Rev. Bd. on maps of L. Assam; Rev. Svy. 1847 till after 1856.	bro. of Anthony (*sup*); re-emp. 1847; m., before 1850.
Pinto, Thos. Edw. ...	...	L. Assam, 1840 till disch., 1842, with less than 5 y. service; 1855, hd. cl. Rev. Commr's. office, Gauhati.	son of C. D. P.; m., Gauhāti, 2-2-55, Gertrude Sophia Mackenzie, wid., dau. of M. Augier.
Porteous, H. A.	Oct. 1836	Chtgg., Mnghr., Mdnpr., 1836 till resd., March 1842; re-emp., 1844.	pr. kin to H. A. P. who d., Calcutta, 9-7-59; of Customs.
Pringle, John Robt. ... b. *c.*, 1819/20	1-3-38	Puri, Sylhet, Cttk., till disch., June 1842; re-emp., N. Bengal, 1845.	son of Robt. P.; m., Kidderpore 27-11-49, Hannah Amelia, dau. of Wm. Thorpe.
Pringle, Walter Hovenden ... b. *c.*, 1821/2	1841	Cttk., 1841 till disch., 1843; ch. brass foundry, Calcutta, 1843-6; re-emp., Bengal & Arakan 1846, till dism., 1856.	bro. to John (*sup*); m., Calcutta, 23-7-45, Caroline Henrietta, Saunders.
Scott, R. H.	22-3-38	Monghyr, 1838.	
Shaw ...	...	Tppra., 1841 till disch., 17-5-43.	
Shaw, Robt. St. John ... b. & ed., England,	May 1836	Azmgr. & Grkpr., 1836-8; ch. Purnea & Mnghr., 1839-41; leave to sea mc., till disch., 1843.	m., Georgina Louisa, who d. Mysore, 12-1-67 after d. of inft. son, 24-12-66.
Smith, Anthony ... ... b. *c.*, 1819/20 dro. in Burrul R., 31-3-50	16-1-37	Sylhet, 1837 till disch., 1842; re-emp. Purnea & Rajshi., till death in camp.	
Smith, Henry Maitland ... b. *c.*, 1813/4 d., Akyab Dist., 12-4-59	June 1835	Ben. Med. Dept., 1829-35; Meerut & Delhi, 1835-8; Blsr. & Cttk., 1838, till disch., 1842; re-emp. 1850 till death.	pr. son of Murray S,, dmn. QMG.'s office; m., Calcutta, 24-8-40, Margaret Bronnon Beatson, wid., née Thorpe.
Smith, Robt. A. ... ... b. *c.*, 1825/6	1-2-41	N. Bengal, 1849-56.	
Stanley	...	Tppra., 1838-41; CD. to B., Rev., 13-1-41.	
Swiney, Geo. S. ... ... b. *c.*, 1823/4 ed., Kddrpr.	Oct. 1841	Cāchār, 1841, till disch., Sylhet, Nov. 1842; Asst. Master, Sylhet Sch., till re-emp. from Jan. 1846.	bro. to John (inf.); m., before 1850.
Swiney, John ... ... d., Assam, Nov./Dec., 1848	17-1-37	Sylhet & Cāchār, 1837-43; Mdnpr. & Hooghly, 1844-7; Assam, 1847, till death.	bro. to Geo. (*sup*).
Thornton, John [385] ...	Sept. 1836	GTS., 1832-6; Chtgg., 1836-8; ch. U. Assam, Nov., 1838, till appd., Sub-Asst. Comnr., 1845.	m., Calcutta, Louisa Hannah Patton.
Stauz	...	Tppra., 1836-7.	to Europe via Alexandria, 7-2-54.
Turner, H.	...	drew Prinsep's map of E. Canal, before 1830 [III, 495]; down-graded, Jan. 1837; Cttk. & Sndrbns., 1838-40.	
Watson, F. C.	...	Blsr. till disch., 1842, with less than 5 y., service.	
Watson, Thos. Edw. ...	1-11-38	Mdnpr. & Hooghly, 1842-5.	
Wilson, Wm. A. [III, 372] ...	...	*v.* Biographical Notes.	

CHAPTER XXIV

INDIAN STAFF

Surveyors & Explorers — Revenue Surveys — Office & Workshops — Khalasis & Followers — Guards & Escorts.

WE have told of the reluctance of higher authorities to employ any but their own European servants on surveying or map-making [III, 388]. By 1830, however, with Lord William Bentinck as Governor General, both the Court of Directors in England and the local governments in India were ready to encourage the employment of educated Indians wherever suitable [342]. By this time the use of the term "native" to indicate any person born in the country had gone out of use, and the survey rolls reserved the term for Indians alone, describing others born in India as European or, when of mixed race, East-Indian [I ; 28 ; n.8].

Though Everest had an immense devotion and admiration for the lascars, followers, and skilled artisans, who worked so devotedly for the Great Trigonometrical Survey, he was at first definitely sceptical of the worth of any Indian for professional work in the field, for he regarded them generally as lacking the capacity either for high precision or self-sacrificing zeal.

These views were considerably modified by the influence of two particular individuals, who served him so well and faithfully, and revealed so much of his own passionate zeal for the cause, that he regarded each, in his own line, as incomparable. The first was the mechanic Saiyad Mir Mohsin Husain, who from humble beginnings had acquired great skill in the construction of high-class instruments and dealing with their troubles with exactness, understanding, and even genius [125]. The second was the Bengali computer Radhanath Sickdhar who came straight from college with so much natural talent and willingness to learn that he not only acquired a complete understanding of all the advanced mathematics and principles of geodesy that Everest was able to teach him but proved himself hard and active in the field, and a first-class observer with all the instruments [340-1].

Waugh writes later of Radhanath and a second Bengali who joined in 1840;

> Baboos Radanath Sikdar and Ramdial De were both appointed Sub-Assistants. The former achieved brilliant success, the latter failed. But...Radanath Sikdar became in reality thoroughly Europeanized, ... being of opinion that no native could succeed as a sub-assistant unless he surrendered his caste and prejudices[1].

From his close association with Everest Radhanath acquired such a complete command of English that in later years many of his letters on professional subjects might almost have been written by the great man himself, except for absence of the characteristic flourishes.

Note has been made of enterprising Indian travellers who had brought back information from beyond the mountains of great geographical interest; pioneers of the trans-Himālayan explorers who were to contribute so much in later years to the geography of Central Asia [II, 40, 353-5 ; IV, 290]. For his adventurous journeys through Afghānistān and Turkistān, Alexander Burnes had the assistance of two Indians, Mohammad Ali from Bombay, and Munshi, as he liked to style himself, Mohan Lal from Delhi [274]. Burnes records that Muhammad Ali

> had been educated in the Engineer Institution of Bombay under Captain G. Jervis [III, 384]. ... He passed safely through the deserts and dangers of Tartary, and now moulders at Vellore [surely Phillaur] where he died of cholera while accompanying me to Calcutta[2].

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[1] DDn. 691 (187), 27-10-56. [2] *Bokhara*, I (ix).

Mohan Lal was not a surveyor, but a most intelligent, live, young man, who maintained a detailed diary of the journey through Kābul, Bukhāra, and Meshed, and the return through Herat, Kandahār, and Peshāwar [276]. He was the son of a Kashmir *pandit* who had settled in Delhi, where Mohan Lal was educated under the aegis of Charles Trevelyan[1] [311]. His fascinating journal was published at Calcutta in 1834, and gives a vivid account of Turkistan and its peoples.

REVENUE SURVEYS

Until the conference of 1833 had placed the *khasrah* surveys of the Western Provinces under control of the professional surveyors, these surveys had been the responsibility of the civil revenue officials working under the Collector. The professional surveyor, with his three or four sub-assistants, and in a few cases one or more Indian *munshis* or *mutsuddies*, confined himself to the boundaries and main topographical features which were to serve as control for the *khasrah* measurements of the fields. In actual practice these latter were carried out with little reference to the professional survey, which alone gave a full picture of the country and its true area within the surveyed boundaries [205–7, 211, 229–30].

To promote speed and economy Indian surveyors had already been employed on the professional survey, and Brown reports from Bulandshahr that

> six mootsuddies have been...instructed in...the use of a circumferentor, keeping a fieldbook in English, protracting on the maps their work, calculating the same in English figures, writing and printing the names of villages in English, and partially to write and read the Hindoostanee language in English ; in fact, everything necessary to render them competent to the duties which before fell to sub-assistants and apprentices. ... The whole expense of the survey now only costs 46 rupees per village, or one anna per acre [III, 389–90 ; IV, 346][2].

Herbert strongly supported this means for

> both cheapening and expediting the...survey. The mootsuddies placed under his tuition... have...fully justified the expectations. ... Captain Brown's experience of their capacity and docility[3] has induced him to recommend that they should be even entrusted with the more important duties of the survey. ... It would be necessary to establish a series of grades with gradually increasing salaries, so as to give them a motive for exertion and good conduct[4].

The most important change introduced at the Allahābād conference was to give the professional surveyor charge of the *khasrah* survey, and the training of Indian measurers to work on sound technical principles, much in the same way as Fisher in Sylhet had improved the work of his *amins* by the introduction of compasses and chains [III, 147–8 ; IV, 211, 213].

Wroughton made an experimental survey near Muttra and recommended that each sub-assistant should have charge of a *khasrah* establishment of "12 mootahseeddies and 30 mirdhas" to "measure the fields and class the varieties of the soil", and keep pace with a professional survey output of "1000 pukka beegahs (of 3600 square yards) per diem"[5] [230–1].

The conference decided against setting up a central school for the Indian surveyors, but to leave each surveyor to recruit and train his own staff. Bedford calculated that an outturn of 1000 square miles of professional and *khasrah* survey could be given by a survey staff comprising one Surveyor in charge—one assistant surveyor—two sub-assistants for professional control and supervision—and an Indian establishment of 1 head native surveyor @ Rs. 30—25 native surveyors @ Rs. 10 and 20, Rs. 375—140 khalassees @ 4 to 6, Rs. 700. Though the Indian surveyors would be largely recruited from the measurers previously working under the district officers, it was hoped to attract many of a higher class ;

> Instructions have been given to the Surveyors for entertaining scholars without delay to be instructed on European principles, with a suggestion that while under tuition they receive 7 rupees a month, to be drawn in contingent bills until 1st October next. ... I...proposed that

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[1] Chas. Edw. Trevelyan (1807–86), BCS. ; Delhi, 1827–31 ; Govr. of Madras ; *DNB.* [2] Rs. 40 per sq. mile ; from Brown, 10–3–31 ; BTC., 28–6–31 (33). [3] teachability. [4] from DSG., 17–8–31 ; BTC., 27–12–32 (29). [5] from Wroughton, Muttra, 14–5–32 ; BTC., 3–7–32 (49).

> 10 rupees monthly pay be allowed from 1st October next to each scholar who may then be qualified, ... and subsequent promotion...will be made at the discretion of Surveyors[1].

Each surveyor was allotted an establishment grant for his party, and was allowed discretion to vary the number employed and the pay of individuals [346-7, 409]. After a few seasons the better men recruited on the initial pay of seven rupees, would rise to as much as Rs. 35, or even Rs. 40 a month, though Stephen reports that he often found a *mutsuddi* just recruited on Rs. 7 would give "just as good work as those who receive from Rs. 20 to Rs. 30"[2].

Difficulty was experienced in collecting surveyors and measurers about a dozen to accompany Patrick Chill to Akyab in 1834 [197], and Bedford expected

> that one or two native surveyors only will volunteer, as the prejudice of the up-country natives against the eastern provinces is very strong. ...
>
> The deficiency might be supplied from Captain Fisher's former survey establishment. His native surveyors never used the theodolite...nor protracted their own work, but can readily survey with the compass, and would therefore answer for the interior, or detail, survey, while one efficient native surveyor who has volunteered from Saharanpoor would answer for the boundary work, superintended and checked by the Assistant in charge[3] [III, 147-8].

When Thuillier started the survey of the Jaintia *parganas* he appreciated the training which Fisher had given the local *amins*, and all the surveyors of the Lower Provinces were quick to promote intelligent measurers, or *lascars* and *khalāsis*, mostly Bengalis, who showed particular aptitude. Mathison reports on seven surveyors who had been three months in his party on Rs. 10 each;

> The two first can work traverse, though not with correctness. They can sketch and survey with prismatic compass with tolerable accuracy, and plot their work. The others...can take bearings with prismatic compass, and have a slight notion of keeping field accounts[4].

Two years later he recommends others for promotion. Two with nearly four years service—drawing Rs. 20 each—could take angles by theodolite "tolerably well", and by compass "very well"—"can calculate areas by scale and compass, and protract and finish surveys very well".

Siddons reports that one of his surveyors, Muhammad Ali,

> has served as khalasee, tindal, and native surveyor on the Chittagong survey since Nov. 1st 1834. He is acute and industrious. His only failing is a somewhat petulant temper, which shews itself now and then in passion with his equals, and sulkiness with his superiors, but when this is *known*, he is easily managed, and if he goes on as he has begun he will be a valuable acquisition to the class of native surveyor. Salary Rs. 12 a month.

Periodical qualification reports were made to the Deputy Surveyor General, whose sanction was necessary for promotion. Surveyors were transferred from one survey to another as occasion demanded.

The general standard of work of the *khasrah amīns* was far better when they worked on contract under the control of the surveyors than when left with the district and settlement authorities; "the aumeens in general will be found very intelligent and willing to do whatever is ordered"[5]. There was a lot of fever and other sickness, and Mathison reports that in Hijli,

> of nine good ameens who were induced to come from Burdwan, six died very shortly, and the remaining three were so ill as to throw up the undertaking altogether after measuring a great portion of their villages. ... Three fourths of the ameens have been laid up. Many are now ill, although they have left that district some months, and several are not expected to recover. ... The climate of Hijeli is in truth an opponent not to be overcome[6] [188].

Siddons writes from Chittagong that at the beginning of the month

> cholera prevailed in Mr. Owen's camp. Two men died and three others were so weak that work was stopped till the 10th inst. I... hope his quitting the boats in which his party have been cooped up since the end of January will have the effect of shaking off the disease[7].

Most survey parties had an Indian doctor on the establishment. As often as not, however, when a party was overwhelmed by some local epidemic, the doctor was amongst the first casualties. Parties were authorized to engage "any trustworthy man of that class...on a salary not exceeding 20 rupees per mensem"[1]. Thuillier obtained from the Civil Surgeon of Sylhet the services of a "native doctor, the only man of the kind available; the salary recommended is 6 rupees per mensem". His qualifications were "very indifferent", and it is hardly surprising that he was "only entertained as a temporary measure"[2].

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[1] from DSG., 15-6-33; BRC., 2-9-33 (15). [2] DLR. 37/53 (2), 1-10-39. [3] from DSG., 9-10-34; BTC., 20-10-34 (1-2). [4] DLR. 37/46 (76), 1-10-38. [5] from DSG., 6-12-41; DLR. 36/7 (331). [6] DLR. 37/47 (58), 16-10-40. [7] DLR. 36/43 (15), 13-4-40.

OFFICE & WORKSHOPS

Though Indian writers were employed as junior copyists both at headquarter offices and, when authorized, with field parties, the great majority of the clerks employed in the Surveyor General's office were European or "East Indian". Some of the very best of the draughtsmen were Indian, but were almost as difficult to find as the East Indians, though generally more content with their pay [336-7].

An account has been given of the Bengali computers working under De Penning at Calcutta, and of their resignation in a body to accept better paid posts under the Revenue Department [337-41]. There was no great difficulty in recruiting others to replace them, though no genius was found to emulate Radhanath Sickdhar, who was only prevented by a special increase of pay from leaving the department to become a school teacher [341-2, 375]. Though shocked at first by their dress [339], Everest writes kindly of his computers;

> I have never seen persons more amiable, who have a more strict regard to the truth, greater sobriety, more amenity of manners, and more general intelligence, combined with modesty. ... The youths educated at the Hindoo College stand proudly pre-eminent in these respects. ...
>
> But the Government of India are not so shallow-sighted as to be insensible to the worth of persons of this class. I never succeeded in training half-a-dozen of these College élèves in my Computing Office, but a sudden call comes, and they are all drained off in a body to fill high and responsible situations in the Revenue Branch, on salaries exceeding those which I give in the ratio of 9 to 1, thus crippling my operations for the time being. ...
>
> At Calcutta the Bengali élèves of this class have an almost insuperable dislike to quit their homes and their native province; wherefore to employ them to any extent...would be by far too costly to be thought of[3].

Pre-eminent in Everest's regard was Mohsin Husain, from the jeweller's shop in Madras, who rose to become his leading instrument repairer, and to succeed to the post of the Company's Mathematical Instrument Maker. To assist him in his travelling workshop Everest recruited up-country carpenters, smiths, fitters, most of whom were placed at Barrow's disposal at Kaliāna for reconstructing the faulty astronomical circles [130-2]. Since the Calcutta workmen had the strongest objection to moving up-country, even for a few months, Everest borrowed men from ordnance depots and magazines, so that Barrow had with him,

> 1st. Sub-Assistant Seid Mohsin, formerly designated Native Artist, a person of natural genius and great quickness, the first native practical turner and mechanic in India, and inferior little, if at all, to Mr. Barrow himself, except in a knowledge of what are called the secrets of the trade. 2nd. The head native smith of the G.T.S., establishment of artificers, ... Kusiali, a young man far above mediocrity. 3rd. Ramdin, a subordinate also above mediocrity.
>
> When, on the conclusion of the base-line at Seronj, the portion of the establishment... shall be free to return, he will have also, not including carpenters,
>
> 4th. Ramdheen, head carpenter of the Surveyor General's office, who has been trained up in my workshop to be an able turner and workman in brass and iron.
>
> 5th. Jowahir, a very able and expert turner, fileman, and smith [and two others].
>
> In addition to these...I have applied to...the depots of Allahabad, Cawnpore, Agra, Delhi, and Fatehgarh, to send to Kaliana two...workmen in brass and iron, out of which...I shall be able to select two or three[4] [130].

Everest was warm in praise of the smith, Jowahir, who,

> when quite a raw village lad, was one of the assemblage of heterogeneous elements...driven by the dearth of 1833 to seek employment wherever they could [26, 408]. ... He came...as a common

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[1] DDn. 623; DSG.'s co. 92 of 8-11-42. [2] BR. 37/60 (30), 30-11-41. [3] Everest (98). [4] DDn. 342 (86-96), 14-1-38.

> carrier on 5 rupees per month, and as he was rather shy and retiring some months passed away before he came into notice. When, however, the scaffolding mast had to be erected, his value and natural intelligence soon made themselves manifest, and he was speedily released from the irksome duty of carrying loads by being transferred to the forge.
>
> At the termination of the approximate operations of 1833–4, an opportunity offered itself ...of giving him permanent employment. ... The sum allowed...was Rs. 11–2–3 per month, but in the first instance I did not chuse to pay Jowahir more than 8 rupees.
>
> The progress of this young man now became most rapid. He seemed to have a readiness of conception, and a knowledge almost intuitive of all the tools and machinery of my workshop, ... and, with a growth of skill almost inconceivable, learned to give that beautiful finish to all he turned his hand to, which made it difficult to distinguish between his performances and those from which he copied, though from the shops of the first-rate London artists. ... I no longer delayed to give him the full salary allowed. ...
>
> When other workmen joined me. ... and he had an opportunity of comparing notes as to their skill, and the wages they received, with his own, ... the only condition on which I could induce him to remain was that of equalizing his pay with theirs, ... at my own cost.
>
> There is...hardly anything to which this young man would not be equal if he had in his boyhood a knowledge of English. ... The merit of having drawn him forth from obscurity, and of having taught him practically all he knows, is, of course, entirely due to Seid Mohsin, who amongst...all classes...is looked up to with a reverence little short of idolatory[1].

Khalāsis & FOLLOWERS

Everest often expressed his unbounded admiration for the trained followers of the Great Trigonometrical Survey, whose spirit of loyalty and devotion—first instilled by Lambton—persisted in every branch of the department more than a hundred years later [III, 309–10]. This spirit of service was jealously fostered by Everest and amongst the rules by which he stimulated *esprit de corps* was that which forbade the use of "the foul name of coolies when referring to the regular servants of the department". They were to be called *lascars* or *khalāsis* [169, 408].

The word *cooly* is really a very harmless one, and had at first been used by Everest quite contentedly [III, 397], but it implies the unskilled labourer or simple fetch-and-carry man. The Indian working man has generally a special trade name indicating his working tool, such as *béldar*, or shovel man [183]. The *lascar* or *khalāsi* is definitely a handy man of skill, able to turn a pair of hands to any of the many essential tasks that fall to the surveyor's profession. The erection of flags on recognizable points—the shewing of heliotropes—the pitching and striking of tents—carriage of scientific instruments—their erection in position—the dragging of measuring chains—and a multitude of other tasks that have to be well done if the survey is to be a success—all these fall to the *khalāsi*. Those who shewed special aptitude were encouraged to become specialists, with prospects of increased pay.

The strength of the department fluctuated, and there were times when large numbers of new men had to be recruited, but with a nucleus of old hands the right spirit was passed on. When Everest came back in 1830 less than fifty of the old gang remained with Olliver's field party. The number required in 1833 was several hundred; each lump could have but the smallest pinch of leaven.

The first task was the measurement of the base-line [12, 40]. Nearly 100 men were required, and much of the work was of a new and most delicate nature.

> There is no difficulty in...obtaining natives for hire...at the ordinary rates of pay...but these...require a vast deal of previous training...in conjunction with others already habituated.
>
> Early in September I laid down a regular system of exercise, and directed Mr. Western to drill the people every morning on the ground attached to the present computing office [49], both at managing the bars without their microscopes, and laying the tressels. From sunset till daybreak between the fifth and twelfth November I had experiments carried on...and divided the whole establishment into four parts. ... Everybody having...been familiarized beforehand with the apparatus, and the part allotted to him, I had...no apprehension of mischief arising. ...

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[1] DDn. 344 (18–26), 25–2–39.

> A very wide difference was found between the people who belonged to the regular establishment, ... even though recently engaged, and those merely hired for the occasion. The former were more alert and attentive, the latter were often slothful and careless.

The party of 2 *tindals* and 79 *khalāsis*, forty being from Olliver's party, was placed under Western's direction:

> In cases of quarrels or other disorders I do not wish you to inflict regular punishment, but to confine until you report to me, except in small matters wherein, without such reference, you can sentence to half-an-hour's walk under the inspection of the sentry, or half-a-dozen rattans, bearing in mind that in general much more is to be done by kind treatment than harshness, and that the less frequent the chastisement the more effectual it is likely to be[1].

In later years there was no such advocacy of corporal punishment, except from Bedford for Revenue Survey parties, and that was promptly forbidden by Government. Occasionally on the other hand young, irresponsible, sub-assistants had to be rebuked or punished for striking or beating their men [387].

Duties were many and various; survey *khalāsis* had to be expert with pickaxe and shovel, to pitch tents, to build piles of stones, to fell trees and cut pickets, carry loads upon both head and shoulders, and protect themselves against robbers, tigers, and bears. ...

> A referring lamp should be placed at or near the meridian, and carefully tended during the whole night [00 1]. The slightest error in the position of the lamp vitiates the whole work, and if they...neglect their business, and do not keep the light properly trimmed, or the reflector truly towards the observer, there is no possibility of attaining any accuracy. ...
>
> If they sleep and leave the light to its fate, there is no means of detecting them, because they plead...that the atmosphere was clouded. The remedy is to entrust the duty to those alone on whose fidelity reliance may be placed, and such persons can be procured solely by proper encouragment and protection. ...
>
> The lights at the instrument must similarly be well tended, and those who approach it must be persons on whom great reliance can be placed, for an injury done to any of the delicate parts would be quite irrepairable. The superintendence of lights, making of tapers, and a confirmed habit of care...in dusting and tending instruments are indispensible[2].

Being anxious to obtain suitable men, and ignoring the difficulties of importing Madrasis to work in small detachments in remote parts of upper India, Everest asked for permission to send a recruiting party to Pondicherry and Madras to bring up about 100 Madrasis, for "the coast people fall into the business of the Great Trigonometrical Survey...more naturally than Hindoostanees do, amongst whom one man will only do one kind of work without reluctance"[3]. He was refused permission to recruit from Madras but was authorized to engage local men.

> to complete...2 parties for...the Great Arc— 6 parties for meridional series. ... I shall not engage these parties to their full strength until I see the time is fitting, because it will expose Government to a needless expence, but as I meet with suitable individuals I shall engaged them and draw their pay monthly. ...
>
> Establishment required for a party engaged on the Great Arc, sa. Rs. 967 12[4];

1	Sirdar	sicca rupees	20	0
12	1st class Flagmen @ sa. Rs. 8 each	,, ,,	96	0
12	men who are competent to use Heliotropes, @ sa. Rs. 8 each	,, ,,	96	0
12	2nd class Flagmen @ sa. Rs. 7/2 each	,, ,,	85	8
58	Carriers [Instruments] @ sa. Rs. 7/2 each	,, ,,	413	4
1	Havildar @ sa. Rs. 12/-, 1 Naib @ sa. Rs. 8/- and 12 Burkundauzes @ sa. Rs. 6/- each	,, ,,	92	0
6	Hurkarras @ sa. Rs. 5/- each	,, ,,	30	0
5	Baggage Tents @ sa. Rs. 22/- each [porterage]	,, ,,	110	0
1	Native Doctor @ sa. Rs. 25	,, ,,	25	0

Waugh and Renny were directed to engaged for each of their parties—

12	1st class Flagmen ...	@ Rs. 8	2	Baggage Tents	@ Rs. 22
12	2nd class Flagmen ...	Rs. 7	1	Havildar	Rs. 12
23	Carriers	Rs. 6	1	Naib	Rs. 8
1	Native Doctor ...	Rs. 25	12	Burkundauzes	Rs. 6
2	Hurkarahs	Rs. 6			

> The high rate of pay...is granted with the view of inducing intelligent and active young natives to attach themselves to the department and until on trial you have met with people really deserving such liberal wages, ... you will only pay...the ordinary hire and carry the balance to the credit of Government. ... The high pay, particularly, of flagmen is only to be

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[1] DDn. 267 (77–9), 19-10-31. [2] to Mil. Dept., 10-8-32; DDn. 283 (125–43). [3] ib. (193–5), 1-11-32.
[4] DDn. 287 (49–52); SG. to MAG., 10-6-33.

granted to such people as...possess the powers of...coup d'oeil...to find out the summits which you direct them to occupy, and to judge...their peculiar fitness as stations [77]. ...

From the 15th August...such men...as may have conducted themselves to your satisfaction you will doubtless transfer to your permanent establishment now authorized, and the others will be discharged[1].

Renny gallantly refused an offer of Everest's best flag lascar ;

Mr. Rossenrode parted with his private factotum servant to me, a man who has been brought up in the G.T. Survey, is a good flag lascar, and well acquainted with every duty. ... It is not then fair to me to deprive you of any of your men, especially as in the delicate...scheme you have now in project [15, 23] there will be occasion for the most effectual assistance.

I am selecting active and intelligent young men. ... retaining them generally at Rs. 5, under written engagement to do everything they are ordered, and under inducement that their pay will be increased according to their capabilities[2].

Pay was regulated by strict rules, and "reference to the superior authority is attended with very inconsiderable trouble".

Everest had already declared that there should be no recess season for the trigonometrical survey ; work was to be carried on throughout the year, shelter only being sought when it was impossible to carry on [348]. Macdonald had trouble with some of his men on the Budhon Series and writes from "Camp near Saugor, 1st October", that

when not required for their more immediate duties, they have been occupied on road making under the Executive Engineer, who pronounces them to be active and spirited workmen. The men of cast are by no means exempted from labour, but the carriers of the kuhar cast (of whom there are seven for the theodolite), have not yet got over their antipathy to pioneer work although they object not to take up stations, fix flags, etc. [400].

to which Everest replied that

the *Kahars* must work like the rest. I know there are men of that tribe to be found who dig their own fields, and will do all other kinds of pioneer work. ... A slight increase of pay will make these people do anything. Pray tell Ganes that he must procure such people, or I shall be displeased with him. ...

Boghalkhund furnishes men of the kind, and it is a most impudent pretention which these low cast men have put up, to which we must on no account yield. Because European gentlemen have given way, and made them domestic servants and all that, they think forsooth they are to be delicate creatures. That idea must be broken down. You must turn them off, and get others who will do as their fellows do[3].

When Olliver suggested giving his more willing men leave to their homes every second year, Everest asked him to follow the

rules which I observe on the Great Arc. ... As soon as the party returns from the field, ... ten per hundred are allowed to go on leave without deduction from their pay. They must have served three years without such indulgence, and be men who merit it. ... If more men require leave on urgent business, they must furnish well accredited substitutes. ... Those who do not chose to abide by these rules—that are clamorous are to be discharged forthwith ; their places filled up, and the circumstances duly reported.

The men are never suffered to be idle, because it spoils them for work altogether. Their proper duties...are to be discharged first ; with these nothing whatever is allowed to interfere. When these are suspended by weather or other circumstances, they are to be employed on any other public duty ; but work must be found for them, for there is nothing so ruinous to a working establishment as a long course of idleness [164][4].

Everest had clear ideas as to ranks and grades, and rebuked Logan for failing to distinguish between a humble *harkara*, and an exalted *chaprāsi* ;

Some months ago, when I requested you to engage a harkara, ... I wished you...to explain... that he was not...a chaprasi, or in any wise assimilated to that class. ... Harkaras of the G.T. Survey were allowed...for the...sole purpose of keeping up a communication with the dawk when there were no dawk roads. It was their business to carry letters, and do nothing else. ...

The lad whom you engaged came up with Mr. Olliver to Mussoorie, dressed...like a chaprasie, and considering himself to all intents and purposes an orderly, or person to dance attendance. This morning, when ordered to take letters from my office to the dawk, he refused, and said it was not his business, and he wanted a khalasi to carry them.

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[1] DDn. 321 (15-7), SG. to Waugh 22-7-33. [2] Agra, 24-9-33 ; DDn. 382 (3-4). [3] *GTS.* VII ; *Syn.* XIV ; (ii-iv—J), DDn. 374 (47 50, 77-80), with SG's reply 15-10-33. [4] ib. (239-40), 14 & 25-6-37.

> Sir, this is not to be tolerated ; there has been some gross neglect of my orders somewhere, or this could never have happened. If you can procure two good harkaras at Saharanpore, send them up immediately[1].

He had but few trained men for his great effort across to Jumna plain [26, 404] ;

> Up to...29th October 1833 I had hardly any native establishment at all, and...there was not half-a-dozen who had ever seen a heliotrope, not one who knew how to use that instrument. My sub-assistants, excepting Mr. Olliver and Mr. Rossenrode, were mostly young raw lads, and from first to last had to be instructed in their duty.
>
> I had but recently organized 3 parties...on the subordinate meridians of Budhon, Ranghir, Amua, which had weakened my resources by...some of my ablest natives. ...
>
> In the end of September I sent a party...to seek for recruits at Meerut, or wherever else they could be found, and on the 20th October this party returned with an assemblage to the number of 100, but it was indeed a sorry collection of heterogeneous elements. The dearth, almost approaching to famine, under which the country was then suffering, had driven from their homes to seek employment many men who had never perhaps passed their village boundary before. There were barbers, weavers, smiths, bricklayers, potters, thatchers, tilers, shepherds, gardeners, musicians, and priests, all with their clownish habits fresh on them, and many of them never having had dealings with an European [261, 404]. ...
>
> My difficulties...disappeared one by one under patience, system, and good example, and before the operations of that season were at an end, many of those who at first seemed so untrained and untameable become efficient and valuable servants[2].

Early in 1835 he writes to the Parasnāth series ;

> The term coolie is abolished throughout my department, and you will cease to designate the flagmen, or any others, by the term [169, 405]. You will send me a list of the whole establishment showing who have evinced particular fitness, ... and who are mere ordinary people, such as can be got when wanted.
>
> You will desist from making the working men of the establishment mount guard, and no guard of any kind is allowed for your private baggage. The native establishment is entertained for the Government business, and not for your private work[3].

Most of the Parasnāth establishment were family men, and on taking the field in 1836 Boileau sent a strength return to the officer commanding the station.

> with a list of the women and children remaining in cantonments at Midnapoor, who have been particularly cautioned to behave themselves discreetly, that they may not...become subject to the displeasure...of Colonel Simpson during the absence of their husbands and fathers[4].

The following year Kallonas asked for a contingent advance of Rs. 500 as "the greater part of the native establishment are involved in debt, and may probably be detained here by their creditors. ... I...recommend their being paid up till the end of October when we march from Midnapoor"[5].

In 1835 Shortrede complained that the establishment allowed for his Bombay survey was far from sufficient ;

> When my assistant and I are in the field we are necessarily separated from each other, and...the present establishment of laskars has been found to be barely sufficient, ... and the jasuds being required...to put up station poles frequently at distances of 50 miles and upwards, I have frequently found them to be too few. ...
>
> Regarding the pay of the jasuds, it may be reduced from 7 to 6 rupees a month, but I do not think any reduction can with propriety be made in the pay of the laskars. The people required to carry instruments are hamals, and they would not remain for less pay, as they are liable to be taken out at all times, and at this moment one half of the whole establishment are in the field with my assistant.
>
> As there are three sub-assistants...for whom no establishment is provided, ... 2 laskars at 8 Rs., or bagaries at 5 Rs. each, may be allowed to each of them when in the field, or otherwise they must be in a great measure inefficient[6].

When he took over official charge at the end of 1836 Jacob was allowed an establishment similar to that sanctioned for the Bengal parties, but had difficulty in finding signal men on the pay allowed ;

> It is notorious that throughout the Bengal Presidency the wages of every kind...are much lower than in Bombay. ... Whereas the lowest rate of pay allowed on the survey is greater

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[1] DDn. 287 (195–6), 19-10-33. [2] DDn. 286 (276–374), 30–8–36 ; para 22 ; GTS. IV. (vi, A). [3] to Andrew Torrick, 27-4-35 ; DDn. 321 (304-6). [4] pr. Edw. Henry Simpson (1784-1845), Ben. Inf ; Col. 1833 ; DDn. 370 (11-2), 9-11-36. [5] ib. (25), 21-9-37. [6] DDn. 518 (9), 25-7-35.

> than can be earned by any kind of labour in Bengal, the highest rate is inferior to the pay of a hamal or mowgami in Bombay. ...
>
> My establishment consists almost entirely of begaries, or ignorant villagers, no persons of any...skill or intelligence having been found, ... and...I still experience frequent delays and vexatious interruptions from the inattention and unskilfulness of the signalmen. ... I...suggest that I be allowed to apply the reductions from the pay of one part of the establishment to increase that of another part, so as not to exceed the total sum sanctioned[1] [347, 403].

When Everest marched to and fro along his Great Arc, equipped for field work and accompanied by officers and assistants, he led a formidable cavalcade, such as this party which he brought back from Kaliānpur early in 1841 [43]. Notice was sent to district officers in advance.

The Surveyor General of India.
Capt. R. Shortrede, 1st Assistant, G.T. Survey.
Mr. J. Peyton, Deputy Computer.
,, W. Rossenrode, Principal Sub-Assistant, G.T.S.
,, W. N. James, 2nd ,, ,,
12 Sub-Assistants, G.T. Survey.
1 Jemadar, 2 Havildars, 2 Naiks, 30 Sepoys, of the 23rd Regt. N. Infantry.
1 Jemadar, 1 Havildar, 2 Naiks, 10 Sepoys, Great Trigonometrical Survey escort [410–2].
1 Havildar, 1 Naik, and 12 Barkandazes [412].
2 Native Doctors.
3 Tindals and 350 Khalasis.
100 Servants and followers.
6 Elephants — 115 Camels — 50 Horses — 100 Bullocks and cows—25 Tattoos[2].

In May 1843, Everest reported to the Superintendent of the Dūn, the local magistrate[3], that one of his men had committed suicide.

> It was the turn of the deceased, Pami, on the 10th instant, to convey the daily dak packets of letters from the G.T. Survey office at Hatipaon [163–6] to the Surveyor General's office at Dehra Dun for delivery to the post office. Instead of making his appearance, ... either at Dehra or Hatipaon, he absented himself till the 11th, and then declared that he had lost the packet. ... He was accordingly placed in the guard. ...
>
> As the packet contained some highly important letters, public and private, every necessary step was taken to...its recovery, but...without effect: and agreeably to the usage...a panchaet assembled to investigate the case [183 n.1], pending which the deceased remained in confinement.
>
> I send you the proceedings of the panchaet which...is the only method I have of investigating cases of this sort, and I...believe that it was the apprehension...that I might eventually deliver him over to your court...which drove him to commit suicide.
>
> In reply to your question as to why the man was not made over to the civil power, ... a procedure of the kind is only resorted to in extreme and unpardonable cases. ... The accused had always borne an excellent character, and I did not think myself warranted in subjecting him to what he would have considered an extreme degradation[4].

On conclusion of the field operations of the Great Arc, Everest recommended a few old men for pension;

> Mutial, the head man of one of the parties, entered the department as a flag man in 1814 under Colonel Lambton. His native place is Chittoor in the Carnatic. He has served very zealously, has been by far the most active, trustworthy, and intelligent native under my orders, and is held in high respect. ... Since 1832, when I appointed him head man, he has been in receipt of Rs. 20 as. 14 per month, but the scale of pay in the establishments which will be formed out of...the Great Arc parties does not allow of this salary. ... It will naturally be... a great hardship after 28 years...to find his salary reduced.. to Rs. 8.
>
> He is an old man (55 years...), having passed the best period of his life in the service of the Honorable East India Company, and it is not probable that he will be fit for a duty which requires young and active men, or give satisfaction in his declining years to a new master. ...
>
> 2nd. Murga, the head man of the other party, entered the department...in 1809. He is a native of Ramnad in the Carnatic. He is similarly circumstanced with Mutial as to salary, and is a well conducted person, but not of the same high stamp of excellence.
>
> 3rd. Chitan Katan, flagman, entered the department...in 1810. He is a native of Madras. His present pay is Rs. 8 as. 5 p. 4, which could be continued to him, but his constitution is quite worn out from repeated attacks of jungle fever, and other hardships, ... and he is in all respects an imbecile, silly, and useless old man, incapable of further activity.

Government sanctioned pension on half salary for all three[5].

General Walker writes thirty years later that the *khalāsis* of the Department are entirely taken from the poorer classes. A few...rise in the Trigonometrical, and a consider-

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[1] ib. (70), 6–2–38. [2] DDn. 406 (11). [3] Henry Vansittart (d. Mussoorie, 1896, aged 79), BCS., from whose son the Castle Hill estate in Mussoorie was purchased for the Survey of India in 1908. [4] DDn. 453 (40–1), 26–5–43. [5] from SG., 1–3–42; DDn. 402 (256–67); BMC., 17–6–42; DDn. 401 (151–64).

> able number in the Topographical and Revenue Departments, to be Sub-Surveyors, but ordinarily they are employed as signallers, carriers of instruments, chain and flag bearers, and generally as attendants on the surveyors. Each survey party has a permanent native establishment containing a sufficient number of trained men to serve as a nucleus to which temporary additions are made during the field season. ...
>
> The bearers of the great theodolites form a very important element, ... for these...are of considerable weight, and though the main parts are separated for carriage, and travel in different boxes, the heaviest package of all may weigh as much as 500 lb., and will require 16 bearers to carry it on their shoulders in relays of 8 at a time. ...
>
> None but men who have been specially trained for the purpose are adapted for this kind of porterage. The men...belong to one or other of the several castes of kahars, or bearers, who from time immemorial have supplied carriers for palankins or litters [406]. ...
>
> The natives of India are generally most serviceable...in all the operations of a survey, if only they are well trained and supervised. ... Patient and long-suffering, inured from infancy to hardship of all kinds, frugal in their habits, and subsisting...on a diet of cereals which would be starvation to most Europeans, they are ready to obey all reasonable orders, to brave all the vicissitudes of climate, ... to accept the grievous risks...of malaria and...pestilence.
>
> Strikes or combinations...to defeat the objects of their employers are of exceedingly rare occurrence, and there are few countries in which men...are ready to do so much, and who give such little trouble in the doing it. ... The Survey is generally a very popular service with them, so that there is rarely any difficulty in obtaining as many recruits as may be required.
>
> Most of the men belonging to the permanent establishment are allowed to go to their homes on half pay during the recess season, ... and on returning...bring a number of their brethren with them...if they have been requested to do so[1].

GUARDS & ESCORTS

Thought at one time Everest had regarded Lambton's permanent escort as an unnecessary extravagance, he had long learned to appreciate the value of a body of armed men whose sole allegiance was to himself [III, 406–7]. He was distressed to find that Walpole had allowed its reduction, and protested to Government shortly after his return to the country that

> the present reduced strength...is not adequate. It is necessary that a sentry should be constantly posted over the principal instrument, which stands under a small observing tent ready for use the moment the atmosphere will admit. That instrument cannot be packed up immediately that the favourable time for observing is over. ... There would be great loss of time in so doing, and...the observations never are so accurate as when the instrument has remained for some considerable time on its stand, and at its post, to settle itself.
>
> The practice, therefore, of keeping that instrument constantly ready for use, has prevailed in the Great Trigonometrical Survey from its very commencement. ... There is no safety for it unless by posting a sentry whose express business is to keep watch over it, for the natives... are childishly prying and inquisitive. ...
>
> Though there is...little fear of an instrument...being bodily carried off, yet the smaller parts are liable to be pocketed as charms, or deranged by the interfering of meddling hands, ... the removal of an eye-piece of one of the micrometers, for instance[2]. The plan which has from the very first been pursued is to hold up that instrument as an object of awe and deference, not to be approached except when some of the...people of the Survey are present [III, 415].
>
> There is a treasure chest with the camp, containing treasure sometimes to the amount of rupees 3,000 or more. ...
>
> The camp...ought...never to be left without a sufficient body of soldiers to furnish two sentries night and day, for which a Havildar's party of 1 Naick and 12 Sepoys will be found the lowest effective strength, as with a less number no allowance is made for sickness, and it seldom, if ever, occurs that any season is passed over without one half of all the people engaged...being disabled. ... 4 rank and file to furnish one sentry is not too much. ... No provision is left for detached parties, of which there are seldom less than four, and often as many as eight. ...
>
> It is not, however, solely against human plunder that protection is needed. The jungles... are quite infested with tigers and bears, and it is necessary to give confidence to people who have to travel, and to sojourn in these formidable tracts, for otherwise they will throw down

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[1] *GTS.* II (76). [2] such pilfering from the GTS. instruments at Victoria Memorial Hall, Calcutta, compelled their being refitted in 1937, and shewn in glass cases until stowed away in 1942 [II, 252].

> the instruments and loads at the very first approach of danger. ... My sole object is that the establishment...may...proceed with their laborious and delicate operations in peace and quietness, under that protection and support which are necessary for their particular duties. ...
>
> I would...recommend...the escort of the Great Trigonometrical Survey to be augmented permanently to the strength specified by my predecessor, ... or...that a Havildar's party of 12 Sepoys...from some one of the regular corps...complete the escort up to that number[1].

The Surveyor General was authorized to demand an escort of regular soldiers when absolutely necessary, and to engage two parties of civilian *barkandazes*. The old escort was to die out, a decision that Everest welcomed ;

> The major part of this reduced body is composed of men who have gone through severe hardships, and are more or less worn out by repeated sickness, fatigue, and toil. ... It would be cruel to discharge them, seeing they could get no other livelihood.
>
> The mode most consistent with the kindness generally shown by this Government...would be to let them continue to receive full pay as long as they can do any duty, and when they are incapable of further exertion to pension them, but to add no new recruits[2].

In 1832 a mounted escort was provided for Rossenrode in Gwalior [24, 152] and the following year Waugh asked that his escort with the Ranghir series through Bundelkhand should include "a duffadar's party of horse and a naik's party of sepahis" to the number of 24.

> The party of 12 barkandazes...is of course too small. ... A party of horse presents many advantages, especially in the rapid conveyance of messages, and in carrying dawk letters when far distant from dawk stations. The 2 harkaras...intended for the latter purpose are evidently incapable of keeping up a communication with a very remote dawk station, and during next season we will be distant from any such station.
>
> The guard of 1 Naik and 4 Sepoys will afford a desirable protection to the instruments. The burkandazes will be employed in occupation of hill stations with parties selecting stations, and in procuring supplies. To obviate the delay, inconvenience, and expense that must follow the removal of markstones, or other injury to the stations, ... it will be necessary to leave at least 1 burkandaz at each of the 6 stations in advance and rear. ...
>
> The guard...can be furnished from Sagur by the Brigadier General in command[3].

Boileau asked for a military guard on the Parasnāth series as he had

> already been robbed to a large amount in the Midnapoor District. The jungles are swarming with wild beasts which annoy us even on the tops of the highest hills, and several villagers have been killed by them during the present season[4].

When surveyors asked for local military escorts, they were to send

> attested copies of such applications to the Surveyor General's office without loss of time. In cases not of emergency...it is prohibited to make applications for escorts without the... consent of the Surveyor General.
>
> Officers...will be...most careful in sending back those escorts to join their corps immediately that the plea ceases to exist, ... and to report their having done so. ...
>
> As long as the Supreme Government are persuaded that no unreasonable call is likely to be made, ... representation from the Surveyor General will...be attended to with tenfold force to what it would be if...such applications are needlessly made[5].

Everest himself set out in meticulous detail the duties of the various guards in his own camp on the Great Arc. Boileau was given command ;

> You will give the sentry over the bazar strict orders to allow no violence to be done to the banias on any pretence. ...
>
> After 9 o'clock no talking or noise of any kind is allowed. ... Up to that hour people may talk as much as they please. ...
>
> You will desire the Jemadar of the N.I. Guard to take a receipt in full of all demands previously to leaving the...encampment.
>
> The sentry over the treasure chest is...to allow no person whatever to approach it except Mr. Mulheran [27].
>
> Escort of the Great Trigonometrical Survey—Regulars ; 1 Havildar, a Naik, 12 Sepoys, to furnish 3 sentries. ...—Burkundazes ; ...to furnish 3 sentries.
>
> Escort of Native Infantry—1 Jemadar, 2 Havildars, 2 Naiks, 30 Sepoys—...7 sentries.
>
> Day sentries (5)—Treasure Chest—Bazar—Native Infantry Guard—G.T.S. Escort Guard & ghurry [clock]—G.T.S. Superintendent's tent.

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[1] to GG. DDn. 265 (172-8), 21-3-31. [2] SG. to Mil. Dept., 10-8-32 ; DDn. 283 (125-53). [3] DDn. 379 (43-4), 1-12-33. [4] DDn. 370 (34, 41), 1-1 & 23-4-38. [5] DDn. 321 (63-4z), 12-11-33.

> Night Sentries (13)—Treasure Chest, 2—G.T.S. Guard, ghurry, & instruments, 2—Superintendent's tent, 2—Native Infantry Guard—Lieutenant Boileau's tent—Chief Civil Assistant's tent—Principal Sub-Assistant's tent—Civil Establishment—Horses—Cattle[1].

Uniform for the permanent G.T.S. escort required an annual supply of red cloth for 14 coats—blue cloth for the facings—Europe pewter for the buttons—plain white lace—white cloth lining—and silk for the sewing[2] [I : 302].

In 1838 Everest asked for the restoration of the old escort to its original strength. He was not satisfied with the civilian *barkandaz* guards who were

> a poor...substitute for trained sepoys, and, rather than go far from their homes, or expose themselves to trouble and danger, ... court an employment of the lowest and meanest kind, such as attending convicts, making one in the retinue of a great man for hire, and so forth. ... My burkandauzes have been persuaded to proceed with me as far as Sironj, but...I shall not be able to place any reliance on their fidelity. ...
>
> I beg...that the regular escort...be restored to its original strength—1 Jemadar—2 Havildars—2 Naiks—30 Sepoys—and that the burkundauze guards be dispensed with[3].

His request being granted, he asked that the escort might now "be armed with rifles instead of musquets. ... To furnish protection against wild beasts in the midst of forests and wildernesses...a musquet is a very inferior weapon"[4].

He enjoyed supreme authority, tempering justice with mercy. After sentencing a havildar to suspension for six months he would formally reinstate him on expiry of the sentence. In another case after the proceedings of a departmental court had been recorded with all military formality he drafted an order in his own hand ;

> Ata Husen, having been found guilty of sleeping on his post at the door of the observatory, is to be...dismissed with disgrace from the escort of the Great Trigonometrical Survey, and considered incapable of ever being employed in the department again in any capacity[5].

On completion of field work on the Great Arc in 1842 the escort was dissolved ;

> As soon as the parties...leave my headquarters [writes Everest]...there will be no guard whatever at my disposal, a state of things which has not happened to the Superintendent since the year 1802. Since the situation of the Superintendent has been held by a field officer, there has been no necessity to trouble the Government...respecting the personal guard, because he had an escort at his own disposal. But the case is entirely altered. ...
>
> The Hon'ble Court of Directors rank my situation with those of the Adjutant-General and Quarter Master-General. The Surveyor General...in the year 1807 had an escort of 1 Jemadar, 3 Havildars, 2 Naiks, 1 Drummer, 1 Fifer, and 50 Seipahis, under the command of a European officer [II, 358]. A personal guard of 1 Havildar, 1 Naik, and 16 Sepoys is allowed by the regulations to a Colonel of a regiment not commanding a principal station. ...
>
> I am an advocate for retaining the escort for the present at its existing strength. ... A trial of 40 years has shewn how much inconvenience is caused...by having escorts furnished from the regular corps, and how much trouble is saved by having a special escort, ... as that is which has now been abolished. ... I am a Lieutenant-Colonel in the army, and...I have a command far more widely extended than that of any Major-General. ... A fitting personal guard should be allowed to me. ... With the sanction...of Government, I will either apply to the Major-General Commanding the Meerut Division for a guard. ... or engage an equal number of barkandazes...until the pleasure of the Hon'ble Court of Directors is known[6].

Government firmly replied that "personal guards are now no longer allowed", and ordered him to restrict demands to occasional escorts for protection of his office[7].

Of the old escort, pensions were allowed to some ; others were enrolled as *barkandaz*. Everest specially urged the claims of

> Jemadar Shekh Ahmed [373], who appears to have served 8 years as a private in the 8th Regiment, Madras Native Infantry, prior to his enrolment in the G.T. Survey escort...in March 1814. ... He was transferred...at the personal request of Colonel Lambton...because he was an active and smart man, and made himself particularly useful in training the new recruits.
>
> He had remained with the escort ever since, has never been on leave nor absent from duty except from real sickness. Was promoted to Naik in 1824, ... and remained in that grade until 5th March 1838, when...promoted to the rank of Havildar, and on 1st June 1838...promoted to the rank of Jemadar [37]. ... He is now an old man, and very nearly worn out[8].

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[1] DDn. 321 (65–7), 15–11–33. [2] DDn. 312 (358). [3] DDn. 342 (100), 26–1–38. [4] ib. (134–5), 18–4–38. [5] Kaliāna, 3–3– & 28–3–39 : DDn. 356. [6] DDn. 402 (371–86), 15–8–42, paras 57–62. [7] DDn. 401 (223–8), 18–11–42. [8] DDn. 402 (256–67), 1–3–42.

In 1833 authority had been given that *barkandaz* or *najib*[1] guards should be allowed for the Revenue Survey [III, 405-6], and in 1832 Bedford recommended that these guards should be calculated on the basis of

1 Jemadar and 12 nujeebs for each Surveyor's undivided camp, or for two if near at hand, vizt., 4 for the detached camp, and 8 for the headquarters. If an officer Assistant be with each Survey...and detached, an additional Jemadar and 4 nujeebs might be advisable, as both the establishment and the public property would then be more equally divided, and 1 Jemadar and 8 nujeebs be required for each camp. ...

Guards in cantonments are...essential. ... Robberies are...frequent. ... One or two valuable instruments carried off and injured would (even if recovered) often more than counterbalance the expense of protection for a twelve month besides embarrassing the operations of the ensuing season. ... Survey records also are valuable and their loss or injury might occasion the necessity of resurveying a large tract at very considerable expense. ...

The monthly expense in cantonments of 1 Jemadar and 4 nujeebs is but trifling, vizt., 21 or 22 rupees, agreeably to the local pay of the Jemadars[2].

Bedford elsewhere pointed out that that the *najibs* employed as guards

are often of an unruly turbulent disposition, and apt to dispute about duty when there is no one in authority over them, and it would be far preferable, ... and very little more expensive in the end, if...2 Jemadars and 16 nujeebs were sanctioned. ... Any troublesome characters could then be kept at headquarters under the Jemadar, and the steadier men detached[3].

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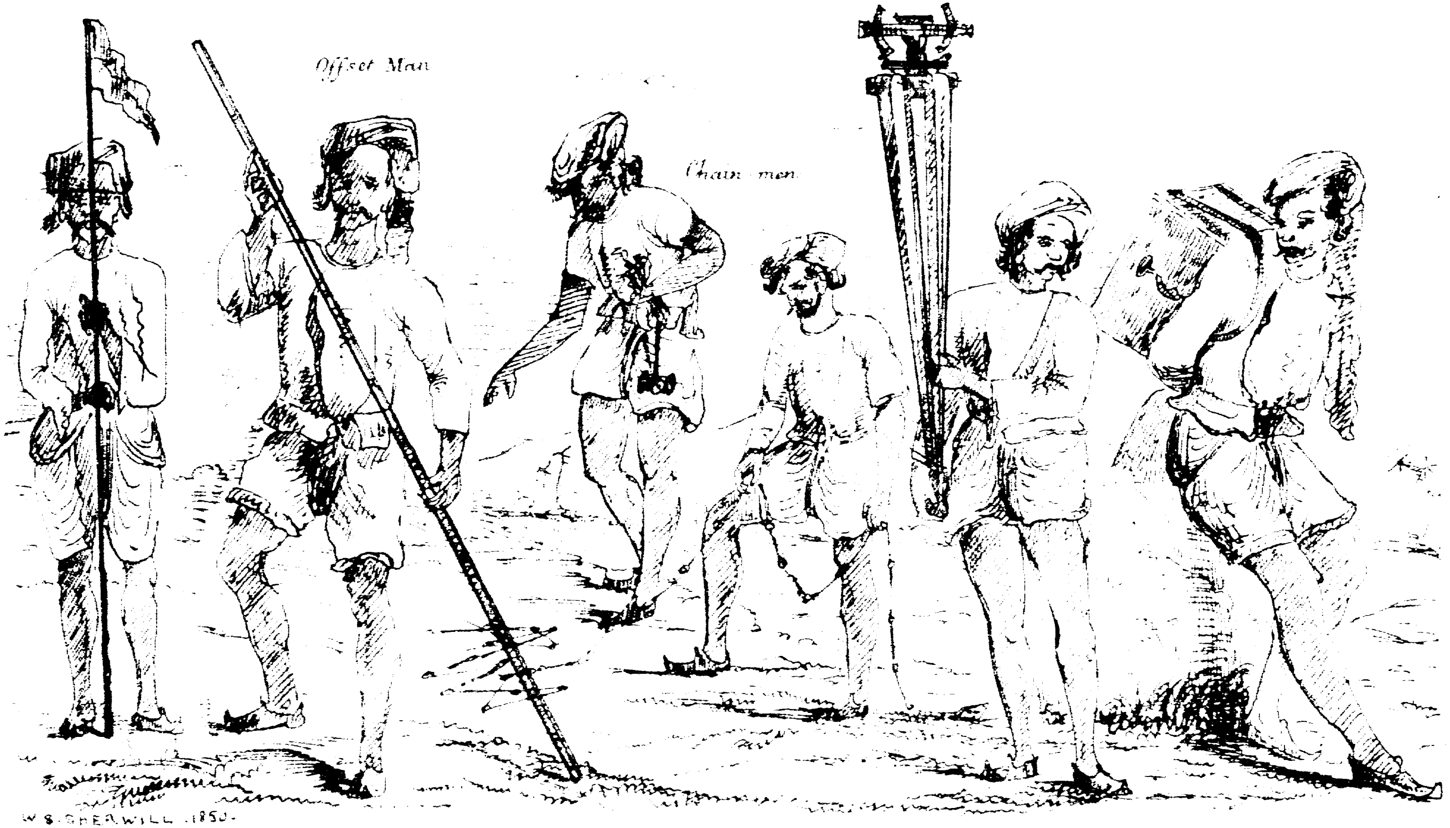
[1] local irregular troops. [2] from DSG., 18-3-33; SRC., 20-5-33 (46). [3] from DSG., 15-6-33; SRC., 2-9-33.

FURTHER ABBREVIATIONS

A R.	Astronomer Royal
A S B.	Asiatic Society of Bengal
Abs.	Absent
Acc/d/y.	Accompan/ied/y
Acct.	Account/tant
Actg.	Acting
Adjt.	Adjutant
Adm/n/ve.	Admitted/Administra/tion/tive
Adv.	Advertise/d/ment
Allce.	Allowance
Appce.	Apprentice
App/d/t/n.	Appoint/ed/ment/ication
Approx.	Approximate
Appx.	Appendix
Archaeol.	Archaeolog/ical/y
Arr/d/g/l.	Arriv/ed/ing/al
Art.	Artillery
Assmt.	Assessment
Asst/ce/d.	Assist/ant/ance/ed
Astr.	Astronom/ical/er
Attd.	Attached
Attdt.	Attendant
Auth.	Author
Autog.	Autograph
b.	born
bapt.	baptized
Barr.	Barrister
Bart.	Baronet
Bn./Batt.	Battalion
Bde.	Brigade
Bdg.	Building
Bdy.	Boundary
Bkmr.	Barrackmaster
Bo Geo Soc.	Bombay Geographical Society
Bot.	Botanical
Brig.	Brigadier
Bro.	Brother
Bt.	Brevet
Bor.	[illegible]
C B.	Companion of the Bath
C D.	Chief Draughtsman/Court of Directors
C E.	Chief Engineer
C I E/SI.	Companion of the Indian Empire/Star of India
C M G.	Companion of St. Michael & St. George
c.	approximately
Camb.	Cambridge
Cant.	Cantonments
Capt.	Captain
Cartgr.	Cartographer
Cav.	Cavalry
Cem.	Cemetery
ch.	chapter/charge/chief/church.
Chmn.	Chairman
Chpn.	Chaplain
Civ.	Civil
cl.	class/clerk
co.	company/county
Col.	Colonel
Comd/d/g/r/t.	Command/ed/ing/er/ant
Comm/t/y.	Commissar/iat/y
Condr.	Conductor
Cons.	Consultations
Corn.	Cornet
Corr.	Correspond/ing/en/ce/t
Cous.	Cousin
Ctml.	Courtmartial
Cult.	Cultivation
cwt.	hundredweight = 112 lb.
D/A/AGQ/MG.	Dep/Asst/Adjt/Qmr/General
D D.	Doctor of Divinity
D I G.	Dep. Inspector General
D L.	Deputy Lieutenant
d.	died
dau.	daughter
Detl.	Detachment
Dir.	Director
Disch.	Discharged
Dism.	Dismissed
Dmn.	Draughtsman
Dr.	Doctor
ed.	edited/educated
edn.	edition
Edin.	Edinburgh
eg.	for example
eld.	eld/er/est
Emp/t.	Employ/ed/ment
Engr.	Engineer
Enl.	Enlisted
Ens.	Ensign
Est.	Establishment
Exm/d/n.	Examin/ed/ation
Expn.	Expedition
Expln.	Exploration
F/G/L/S.	Fellow of the Geological/Linnean/Society
F M.	Field Marshal
F R/AS/As Soc/GS/S.	Fellow of the Royal/Astr./Asiatic Geographical/Society
Fd/Engr.	Field/Engineer
Frpce.	Frontispiece
Ft.	Foot/Fort
Furl.	Furlough
Fusrs.	Fusiliers
G B.	Great Britain
GC/B/SI.	Grand Cross of the/Bath/Star of India
G P O.	General Post Office
GT Rd.	Grand Trunk Road
Gall.	Gallery
Garr.	Garrison
Gds.	Guards
Gdns.	Gardens
Geog/r/l/y.	Geograph/er/ical/y
Geol/gt.	Geolog/ical/ist
gt g son.	great grand son
H M.	Her/His Majesty's
H R H.	Her/His Royal Highness
HQ/Hdqrs.	Headquarters
H Art.	Horse Artillery
Hd.	Head
Hdbd.	Hyderabad
Hughly.	Hughli
H S.	House
Hon.	Honour/able/ary
Hosp.	Hospital
Ht.	Height
H/drgr.	Hydrographer
I G.	Inspector General
I N.	Indian Navy
Inhn.	Inhabitants
Infy.	Infantry
Inspr.	Inspector
Instn.	Inst/itution/ruction
Inst	Instrumental
Intpr.	Interpreter
Inv.	Invalid/ed
J.	Jupiter Planet
J P.	Justice of the Peace
junr.	junior
K C B/CSI/H/LS.	Knight Commander of the Bath/Star of India/Hanoverian Order/Lion & Sun
K & J.	Khasi & Jaintia
Kd.	Killed
Kt Bach.	Knight Bachelor
L I.	Light Infantry
L L D.	Doctor of Laws
Lat.	Latitude
Lib.	Library
Lieut.	Lieutenant
Lith/d/r/y.	Lithograph/ed/er/y
Long/l.	Longitud/e/inal
Lt.	Lieutenant/Light
Lt Col.	Lieutenant Colonel
M A G.	Military Accountant General
M D.	Doctor of Medicine
M I.	Monumental Inscription
M I C E.	Member of the Institute of Civil Engineers
MIM.	Mathematical Instrument Maker
M N I.	Madras Native Infantry
M O.	Medical Officer
M/P/RCS.	Member of/Parliament/Royal Coll. of Surgeons
m.	married
mc.	medical certificate
Mag.	Magazine
Maj.	Major
Marq.	Marquis
Matric.	Matriculation
md.	maund = 80 lb.
Meas/d/g/t.	Measur/ed/ing/ement
Med.	Medical/Service
Merch.	Merchant
Merdl.	Meridional
Metl.	Meteorological
mo.	months
Mhdn.	Muhammadan
Minl.	Mineral/og/ical/y
Mssny.	Missionary
N I.	Native Infantry
N P G.	National Portrait Gallery
Nat.	Nat/ural/ional
N S W.	New South Wales
neph.	nephew
nr.	near
Nvgn.	Navigation
ob.	obituary
obs/d/g/n/y.	Observ/ed/ing/ation/atory
Offi/r/d/g.	Offic/er/iat/ed/ing
Opns.	Operations
Ord.	Ordnance
Oxon.	Oxford
P M G.	Postmaster General
P R S.	President, Royal Society
P S.	Private Secretary
P W I.	Prince of Wales I., Penang
p.	page
pm.	per mensem, monthly
pens.	pension
Photo.	Photograph
Postmr.	Postmaster
pr.	probably
prcpl.	Principal
Prof.	Profession/al/or
Pymr.	Paymaster
Qmr.	Quartermaster
R A.	Royal Academy/Artillery
R/AS/As Soc.	Royal/Astronomical/Asiatic Society
R/GS S.	Royal Geographical/Society
R E/M.	Royal Engineers/Marines
RM/A/C.	Royal Military/Academy/College
R N/R.	Royal Navy/Naval Reserve
R S G.	Revenue Surveyor General, Ireland
R U S I.	Royal United Service Institution, London
Rd.	Road
Recce.	Reconnaissance
Recd/d/g/n.	Received/ommend/ed/ing/ation
Regr.	Registrar
Regtl.	Regimental
Resdt/cy.	Residen/t/cy
Retd.	Retired/ment
Rlwy.	Railway
S A.	South Africa
S C.	Staff Corps
S E.	Southeast/Superintending Engineer
S K.	Storekeeper
S P G.	Society for Propogation of the Gospel
S & M.	Sappers & Miners
S S O.	Station Staff Officer
sa.	*sicca* (rupees)
Sch.	School
Senr.	Senior
Sgt.	Sergeant
Sis.	Sister
Soc.	Society
sq.	square
St.	Street
Sub-Asst.	Sub-Assistant
Subst.	Substantive
Succ.	Succeed/ed
Sup/dg/t.	Superintend/ing/ent
Surg.	Surgeon
Surv/d/g/r.	Survey/ed/ing/or
sv.	under the heading
Svy.	Survey
Tempy.	Temporary
Topo.	Topographical
tr.	transferred/lated
trgd/n.	Triangulat/ed/ion
Trig.	Trigonometrical
Uncov.	Uncovenanted
Univ.	University
unm.	unmarried
Vol.	Volume/unteer
W I.	West Indies
wid.	widow
wr.	writer, clerk
y/r/st.	year/younger/est



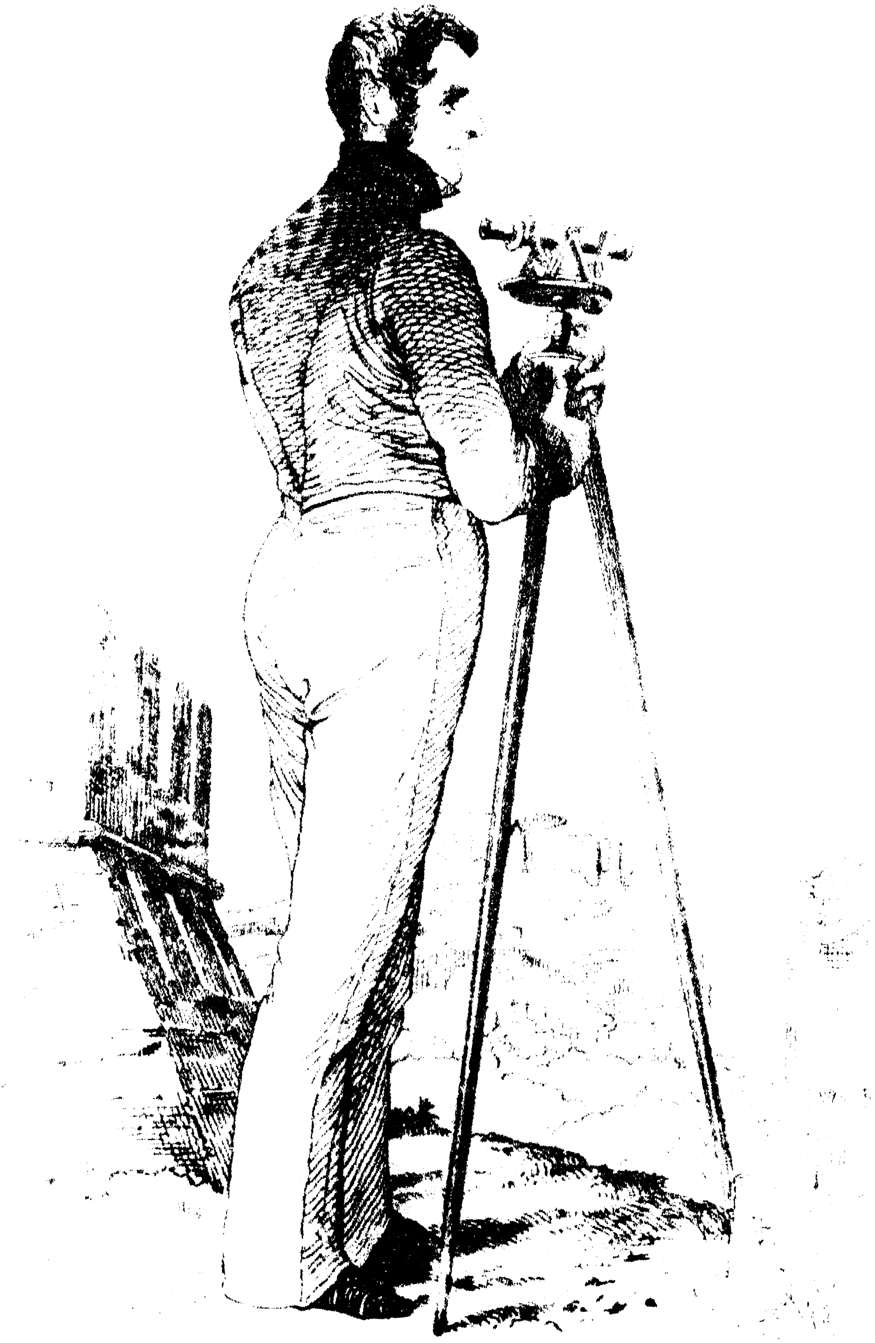
REVENUE SURVEY KHALASIS
BIHĀR

W. S. Sherwill
Major.

No. 5408 HD'51-800'53

Sketch by Walter Sherwill (1815-90), Revenue Surveyor, from

Printed at the Survey of India Offices



A. H. E. Boileau

ALEXANDER HENRY EDMONDSTONE BOILEAU (1807–62)

Bengal Engineers. On topographical surveys 1827–32. With G. T. S. 1832–38 [vol. III, p. 426].

Portrait by Colesworthy Grant, *India Review*, Calcutta, June 1840.

BIOGRAPHICAL NOTES

For Bombay Revenue Surveyors *v.* p. 369.

ABBOTT, Augustus. Ben. Art.

b. 7-1-04. d. 25-2-67.

2/Lt. 16-4-19 ... Col. 14-11-58 ; ret. 1859 ;
M Gen. 13-4-60.

Eld. son of Henry Alexius Abbott, of Blackheath, ret. Calcutta merch., and Margaret Welsh his wife.

With 3 yr. bros., Frederick [III, 74]—James [*inf*]—and Saunders Alexius [417]—had distinguished career in Ben. Army. The yst. bro., Keith, was Cons. Gen. at Tabriz.

m., 1st., Karnāl, 14-9-35, Charlotte, dau. of Robt. Becher, survr. & DQMG. [III, 422]; she d., Mussoorie, 26-6-39, aged 31.

m., 2nd., Fatehgarh, 23-3-43, Sophia Frances, dau. of J. H. Garstin, HM. 88th Regt.

ed. Winchester & Addiscombe. CB. 1842.

DNB. ; *DIB.* ; Hodson, I (1) ; Low, C. R.

Not a survr. ; mil. service, Bharatpur, 1824-5 ; Shekhāwati, 1833-4 [272] ; Afghān Wars, 1838-9, 1841-2 ; Commy. & Inspr. Mags., Meerut, 1854.

ABBOTT, George. Ben. Inf.

b., Calcutta, 26-11-03.
d., Sambalpur, 1-4-38, on svy.

Ens. 16-1-24 ... Capt. 10-1-38.

Son of George Edward Abbott, merch. & Hd. Asst. GPO., Calcutta, and Ann Maria his wife, dau. of Rev. H. P. Stacey, Ben. chpn. Had two bros. in Ben. Inf., but not related to Augustus [*sup*].

Hodson, I (2) ; pub., 1827, "Views of the Forts of Bhurtpore and Weire", 13 lithd. plates ; Calcutta, 1830, "Views about Kurrah Manickpore in the Province of Allahabad".

JASB. VIII, 1839 (367, 613), deputed on road svy. from Orissa to Sambalpur ; "commenced his travels early in Jan. 1838, was taken ill on the 22nd March near Keunjargarh, and died two days after his arrival at Sumbulpur", thus, writes Kittoe [452] "having fallen an early victim to the deadly climate of the Keunjur and Mohurbhunj jungles [and] to the distracting knavery of the people he had to deal with.

"Every follower...suffered more or less from the deadly climate ; ... his Bengallee servant, a sepahee and another servant, died shortly after their arrival at Sumbulpur ; there were several others in a dangerous state who subsequently died on their way home.

Kittoe was led from Lehra by a Jemadar who "asserted that there was no better road, but like most natives he had but a very poor idea of a straight line, or of the points of the compass, hence much of the trouble which Capt. Abbott had to complain of.

"After proceeding several miles down the valley, ... I entered a narrow glen with large forest trees. I here came upon the road Capt. Abbott had surveyed, very near to the village of Tillopussi.

"May 31st., reached Koddoogurh ; ... the high hill of Keonjhur called Baghtunga was right in front ; ... a pretty village called Koomri. ... Iron ore—very narrow road—it was this very ghat that poor Capt. Abbott had refused to travel over, and well he might".

ABBOTT, James. Ben. Art.

b. 12-3-07. d. 6-10-96.

2/Lt. 6-6-23 ... Col. 18-2-61 ; Gen. 1-10-77 ;
ret., 1879.

bro. to Augustus [*sup*] and Saunders [417].

m., 1st., Calcutta, 8-2-43, Margaret Ann Harriett, dau. of J. H. Fergusson, of Trochraigne, co. Ayr ; she d., Asirgarh, 11-2-44.

m., 2nd., May 1868, Anna Matilda, dau. of R. H. de Montmorency, Ben. Inf., and niece of Hervey Francis de M., survr. [III, 437] ; MI. Guildford cem.[1].

ed. Taunton & Addiscombe. CB. 1873 ; KCB. 1894.

DNB. ; *DIB.* ; Low C. R., *Heraut to Khiva* ; Hodson, I (3).

1826, at capture of Bharatpur [III, 426, 462].

1832, brought to notice of Bentinck, GG., for possible employment on rev. svy. ; BGO. 12-10-35, appd. Asst. Survr. on rev. svy., Azamgarh [362] ; tr. to Sahaswān, arrg. Bareilly Feb. 1836 ; succ. to ch. 6-8-36, and extended svy. through E. Rohilkhand [215, 221, 234, 368] ; appd. full Survr. from 1-1-38[2] "an able young officer".

July 1837, Bareilly, had spirited corr. with local bde. comdr., John Tombs, who complained of his failure to report his arrival from camp [II, 389], and of his appearance in church in full beard of more than a year's growth. Abbott promptly made personal call, but explained that he was in civil employ, and asked that the Brig.'s orders should be addressed through the civil authorities. He was living 4 m. outside cantonments.

The bde. maj., Humphrey Hay, again wrote officially; "From the moment you entered into the Bareilly district you ought to have reported the circumstance for the Brigadier's information, every military officer within Rohilcund, no matter how employed, being subject to his control.

"At this inclement season [June], the Brigadier would not have expected a call from you ; but, having seen you at the station church, or building appropriated to divine service [the sessions court house], he is of opinion that you failed in a mark of respect. ... By not reporting your return... either in person or by letter, you have disobeyed the order of the Commander-in-Chief. ... When you resume your survey in the country, you will, of course, have the opportunity of resuming the beard also, if you please. Officers of Local Horse are alone permitted to wear hair on the chin and face".

Abbott replied that he could not accept orders from the mil. staff "that may...be directly at variance with the instructions of the Sudder Board of Revenue". He pointed out "that I did duly report my arrival in his district in February 1836, which district I have not since quitted—also that the church is held in the Civil Lines".

He again attended service unshaven, and had another letter from the bde. maj. in which "the Brigadier hereby prohibits your attendance either at church or at any public place of assembly until you shall have removed the long hair from your face and chin". Abbott replied that as a matter of courtesy he would so far respect these wishes as to attending public assemblies.

He then sent copies of the corr. to the DSG., asking that it should be laid before the Lt-Govr., adding that he had worn his beard for 16 mo., and that his predecessor, Fraser, had also worn a beard for several years whilst actually residing in cants. The Rev. Bd. forwarded the corr. to Govt., deprecating mil. interference with survrs., but the NWP. Govt. replied that mil. survrs. should comply with mil. orders regarding etiquette, dress, and deportment, but not with any interference with svy. duties[3].

Joined Army of Indus at Ferozepore, Nov. 1838 [281-2], reaching Kandahār April 1839. Appd. Pol. Asst. with D'Arcy Todd, Envoy to Herāt. Arrg. there June, was sent with Shakespear [465] on pol. mission to Khiva, and on to Europe [283]. An account of this hazardous journey is given in his two vols., *Narrative of a Journey from Heraut to Khiva—Moscow—and St. Petersburgh*[1].

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[1] designed by Sir James, who was skilled artist, specially with pen & ink. [2] NWP. Rev. Bd., 20-4-38 (80). [3] ib. 25-7-37 (29-30) & 22-8-37 (24) ; cf. *Monthly Rev.* XI, No. 6, April 1947 (22-3).

Passing through Kābul, "ignorant of every particular... connected with Toorkestan", including the language, Abbott reached Khiva in Jan. 1840, stayed two months and then started for Russia. Narrowly escaped with his life in scuffle with Cossacks on Caspian shore—taken prisoner—released, and reached England via. St. Petersburg. Unable to record any geogl. obsns. or notes[2].

Main purpose of mission, negotiations at Khiva for liberation of Russian captives, had met with surprising success, for which he received special thanks from British Govt. Honoured by dining with Presdt. of India Bd., who describes him as "in full uniform of a sort of Turkish or Russian pattern, and with large mustachios, and spurs on his boots. His manners were most formal, and rather submissively ceremonious. He never spoke except to answer a question, but all he said was much to the point, and there was a determined gravity about him, very useful, I should think, in his intercourse with such men as the Khan of Khiva"[3].

On return to India Abbott did not return to the "active and engrossing duties as a revenue surveyor" but was appd. Ex. Offr. at Hijli, Midnapore[4]. After 1st Sikh War took pol. service under Henry Lawrence who "finding that the appointment I held in Bengal was ill-suited to my taste, recommended me for the office of Commissioner to define the boundaries of States in the Punjab, and afterwards, on completion of this duty, recommended me for the office of Deputy Commissioner in Huzara". From this time [1846], and for about seven years and a half, I was under the orders of my old friend Sir Henry Lawrence"[5]. It was from his ch. of Hazāra that the hdqrs. town took the name of Abbottābād.

JASB. xvi., 1847 (989, 1135 7), Abbott sends to ASB. minl. specimens and describes geology of Hazāra Dist.; ib., xvii, 1848 (619–33), paper on "Battlefields of Alexander & Porus", with map of Jhelum R.

ABBOTT, Saunders Alexius. Ben. Inf.
b. 9–7–11. d. 7–2–94.

Ens. 12–6–28 ... Col. 25–1–61 ; ret. 27–10–64 ;
Hon. M Gen. 24–1–65.

bro. to Augustus and James [416].

m. Allahābād, 15–2–39, Harriet Margaret, dau. of James Johnstone, Surg., Ben. Med.

ed. Addiscombe, 1826–8.

DNB. ; *DIB.* ; Low. C. R. ; Hodson, I (4).

1834, Shekhâwati expn. [372].

Jan. 1837, joined rev. svy., Gorakhpur (E), actg. in ch. during leave of Lawrence, March to Oct. ; with Lawrence to Allahâbād, 1838, holding ch. Cawnpore 1838–9 ; and in succession, Jaunpur, Jalaun, Jhānsi, till svys. closed down [215, 226–8, 234, 362, 368, 391, 453–4]. An exceedingly capable survr.

Oct. 1842 reverted to duty under C-in-C. ; 1843, pol. duty with AGG. NWF. Ambāla ; Dec. 1845, wounded at battle of Ferozeshāh.

JASB. xiv, 1845 (lix) ; Robt. Leech writes from Ambāla, sending a map ; "I am indebted to my friend Capt. Abbott who succeeded me in charge of the district of Uglhul for the loan of surveying instruments, and of his valuable map of the district".

From 1844, Asst. AGG. NWF. & DC. Cis-Sutlej Dists., supervising and countersg. dist. rev. svys., including MRIO. Rev. Svy. Misc., Thānesar, Ambāla.

ANDERSON, John. Ben. Engrs.
b. 18–8–10. d. Lucknow, 11–9–57.

2/Lt. 15–6–27 ... Lt Col. 20–9–57.

Son of George Anderson, merch.

m., Hazāribāgh, 5–10–37, Elizabeth, dau. of Alex. Dingwall, postmr. of Aberdeen, and sister of wife of Geo. Thomson, Ben. Engrs. [iii, 507].

ed. Addiscombe, 1826–7.

Hodson, I (32–3) ; Thackeray (91) ; Conolly (87/151).

1838–40, survr. to Army of Indus, Ferozepore to Kandahār with Henry Durand as asst. ; on sick list, Kābul [240, 281–2, 306].

Several years on canals and with PWD. ; CE. Oudh, 1856 till death.

ANSTRUTHER, Philip. Mad. Art.
b. Madras, 11–9–07. d. unm., 18–2–84.

2/Lt. 17–6–24 ... Col. 1–5–55 ; ret. 4–11–58 ;
M Gen. 18–3–59.

Son of Sir Alex. Anstruther, Kt., Recorder of Bombay, and Sarah his wife, dau. of Thos. Prendergast and wid. of Capt. W. Selby.

ed. Westminster 1818–22 ; *OW.* I (22) ; described as "a little red-haired boy", *v.* unpub. diary of Francis Gresley (1807–80), Hodson, *II* (335–6).

CB. 1842.

1840–41, China War ; MRIO. 87 (38), svy. of Jinghae [200] ; taken prisoner.

ARROWSMITH, John [iii, 517]. Cartographer.
b. 23–4–1790. d. 2–5–1873.

Nephew of Aaron Arrowsmith (1750–1823), cartographer, *DNB.* [ii, 285 n.8].

b. on farm at Winston, 6 m. E. of Barnard Castle, Durham. *RGS. Progs. XVII* (243–5).

Arrd. London, 1810, to join his uncle Aaron, after whose death he set up his own business, compiling many maps of India [240, 277, 288, 292, 294, 304, 424, 426] ; on his cousin Samuel's death, bought the old family business, and carried it on at 10 Soho Sq. till 1861.

1863, Patron's Medal. RGS.

AYRTON, Frederick. Bo. Art.
b. 20–3–12. d. 20–6–73.

2/Lt. 12–6–28 ... ret. as Bt. Capt., 11–9–43.

Son of Frederick Ayrton, solicitor.

m. Whitnell, Herts, 13–8–33, Margaret, dau of late G. Hicks ; she d., Poona, 4–11–38.

5–12–37, appd. asst. rev. survr., Deccan ; resd. before Feb. 1838 [306, 309].

Ret. owing to bad sight ; called to Bar, Middle Temple, 1846 ; Sec. to Abbas Pasha, Viceroy of Egypt, 1851–72.

BAKER, William Erskine. Ben. Engrs.
b. 29–11–08. d. 16–12–81.

2/Lt. 15–12–26 ... Gen. 1–10–77.

Son of Capt. Joseph Baker, RN. ; his sister Josephine m. John Colvin, Ben. Engrs. [iii, 433].

m., Karnāl, 29–6–37, Frances Gertrude, dau. of Gen. Alex. Duncan (1780–1859), Ben. Inf.

ed. Addiscombe, 1825–6 ; Chatham, 1827.

KCB. 1870 ; *DNB.* ; *DIB.* ; Hodson, I (80).

From 1834, asst. supt. Delhi canals ; *JASB.* ix 1840 (688–94), "Report on a line of levels...between the Jumna and Sutlej rivers" ; Feb. 1840 levelled line between Karnāl and Ludhiāna, through Patiāla, to serve passage for boats [390].

1842–3, survd. "watercourses and canals" of Sind [246] ; MRIO. 117 (22), svy. Tatta to Allahbund.

From 1851 Consulting Engr. to Govt. Rlwys.

BARROW, Henry. Math. Inst. Maker.
b. 1790/1. d. 2–4–70.

Appd. MIM. to HEIC. 1830 ; arrd. Calcutta, 4–10–30 ; disch., Calcutta, 19–4–39.

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[1] Low, C. R. (64–5) ; Davis (30). [2] Journal, *IO. Cat.* (472). [3] Broughton, *Recollections* (295) ; quoted by Davis (29–30). [4] DDn. 415 (13), Abbott to DSG., Hidgellee, 30–9–45. [5] Edwardes (453).

FRAS. 9–3–49.

His wife, Elizabeth Mary, followed him with 6 children, arrg. Calcutta May 1831. His 2nd son d. Calcutta, 20–10–32, aged nearly 7 y.; two sons sailed for London Feb. 1834. His wife d., Calcutta, 11–11–34.

In 1829 he was "a small worker for the trade, residing in Lambeth Road". He worked for the leading inst. makers, including Troughton and Dollond, making "small theodolites, sextants, and such like. ... He had...erected a small observatory on the roof of his house at his own cost, and stocked it with instruments of his own making".

Jan. 1829, introduced to Everest as a worker of "ability, punctuality, and unimpeachable integrity", who made from £ 300 to 400 a year. To the Directors' anxiety as to how a man of his age would stand up to the Calcutta climate, Everest replied that, "as he is a person of temperate habits" he would probably "manage with proper precaution"[1] [2, 122].

On arrl. Calcutta drew salary @ Rs. 500 "monthly, instead of quarterly, ... and...house-rent at...90 rupees a month...from the 4th of October till the 4th December, the period during which he was... living at a hotel". He made family remittance home @ Rs. 500 a quarter which "ceased from May 20th 1831"[2]. He found "the expense...at the Calcutta hotel...considerable" and from Dec. 1830 moved to No. 7/6 Theatre St. [125], the building hired as workshop. Resented Everest's constant visits to the workshop. He had long been his own master in London, and did not appreciate the SG.'s interest in the detailed construction and design of insts. Angry words were exchanged on more than one occasion, which Everest reported in detail to Govt., insisting on written apology [122].

Tension was relieved when Everest left Calcutta, and Barrow was left in undisputed ch. of his work, taking general instructions through De Penning. Amongst other tasks he completely renovated Lambton's 36-inch theodolite, henceforward known as Barrow's [39, 124, 126, 135, 142–3, 314; pl. 6]. Even now angry letters passed from time to time, when Everest found that priority was being given to tasks other than those of the all-important GTS. [15, 123, 127, 148, 458].

As a member of ASB. Barrow joined in astr. and metl. obsns. [114]. In 1849 he was elected Fellow of RAS.

July 1837, called up-country to undertake reconstruction of astr. circles on Everest's design [5, 41, 127, 132, 140, 341, 430–1]. Left Calcutta 11–8–37 without protest, arrg. Dehra Dūn 11–9–37, and joining Everest at Kaliāna; wrote happily a few weeks later [123].

Two months later wrote in a very different tone, both direct to the Mil. Dept. at Calcutta, and to Everest who was watching the base-line meast. at Sironj [53]. Reported that he could not get the work done at Kaliāna—"after nearly 3 months experience I am convinced of its utter hopelessness, though in Calcutta, with the conveniences... there obtainable, there would be no great difficulty[3]".

On Everest's urgent protest, Govt. ordered that Barrow must await his return to Kaliāna. Making all speed back from Sironj, Everest was deeply disappointed on his arrl. 9th March at the lack of progress made. He took immediate ch. of the work, gave Barrow definite tasks, and brought in Mohsin Husain for essential parts of the work [6, 132–3].

Barrow submitted to be thus closely directed—the reconversion of the circles was really beyond him—and considerable progress was made after the move to the hills [132–3, 160, 404]. Towards the close of the rains, however, trouble flared up again, and Everest writes a letter very similar to one he had written to Barrow in Calcutta more than six years before;

"The manner in which on two occasions you have lost sight of the deference due to my rank and station renders it incumbent on me to take efficient measures for the maintenance of...decorum. ... I lay down the following rules: ...

1st. All applications which you may have to make to me will be made in writing in an official form.

2nd. Whenever you may desire to communicate your opinions to me...on professional points, you will be pleased to notify your wish...in writing; I will appoint a time to receive and attend to you.

3rd. You are prohibited to commence any verbal discussion with me in the workshop, or elsewhere, ... unless invited by me to do so, and on all occasions of our meeting you will be pleased to confine yourself to the ordinary greetings of civility and courtesy which the usage of civilized society prescribe[4].

He reports the incident to Govt.; "everything seemed to advance most prosperously until the 29th August, when to my surprize Mr. Barrow on a sudden applied to me verbally for leave to go...to Calcutta...to meet his son. I pointed out to him the impossibility...whilst the instruments were yet in an unfinished state, assuring him at the same time that I should...[do] all in my power to accommodate him when they were accomplished. But this...seemed to irritate him to that extent that he began to be impertinent. ...

"Two days after this, without any provocation whatever, he accosted me again in the workshop in the same aggravating style of impudence, which obliged me again to call him to order. ... and he...broke forth into a strain of great contempt of my proposed method of dividing, which for the first time I now learned would in his opinion be impracticable [125–5, 133–4].

"Immediately...I took the precaution to address Mr. Barrow an official letter interdicting him from all verbal communication. ... His temper was so ungovernable as to render him like a crazy creature, ... so that every verbal discussion, except in presence of witnesses, was in danger of misinterpretation. ...

"He then appears to have given way to his determination of neither dividing the circles, ... nor of assisting in the operation, ... and to this determination he adhered. ...

"Mr. Barrow remained until the axes were ground, the faces of the circle turned, and the instruments put up...at Kaliana, and finally adjusted and tested[5]".

The last two months at Kaliāna were very difficult, and a long series of acrimonious letters passed between these two obstinate men. Everest's position was the more difficult, because he was desperately anxious to push forward the completion of his insts., in which he was indeed marvellously successful. Barrow had the easier part of refusing to co-operate, but he was obviously utterly disgusted by Everest's close control, and only looked for escape.

In the course of technical arguments fired back from one to another, Barrow countered a disclaimer of Everest's to the mechanical genius of a Ramsden with the remark that "I think it would have been quite as well if you had the same distrust of your mechanical powers before you had altered the 2-feet circles by Troughton, who as a mathematical instrument maker stood pre-eminent".

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[1] from Everest, 4–11–30 & 14–1–38; DDn. 265 (70–4); 342 (86–89).
[2] SGO. Pay bills & DDn. 263 (216–8), 31–12–30.
[3] DDn. 341 (183–4), 29–12–37.
[4] DDn. 348 (298–9), 2–9–38.
[5] Report, 3–8–39 (128–33).

To which Everest retorted that "though you are at liberty to think just what you please, yet an official letter is not the proper channel wherein to give vent to impertinent comments on me or my proceedings. When I seek your favourable voice, or care for your disapprobation, it will be time enough to communicate either to me[1]".

Everest enjoyed the dual role of SG. and STS., conducting all the corr. in role of SG., but referring to himself as STS. for technical comments. He writes on 23rd Jan.: "On receipt of your letters dated 19th and 21st instant, I handed them to the Superintendent of the G.T. Survey, a copy of whose report sent to my office is enclosed for your...guidance. ...

"I cannot allow any deficiency on your part in that deference which is due to the rank and station of the Superintendent of the Great Trigonometrical Survey. ... You must be well aware that it is improper...to sit with your hat on your head, and...common notions of delicacy would have prevented you from introduing yourself uncalled for, whilst the Superintendent and his subordinates were occupied, under orders from my office, in inspecting instruments pronounced by you to be in working order"[2].

Indeed, STS. had reported to SG. that "whilst I was engaged yesterday with my two sub-assistants, Seid Mohsin and Babu Radanath Sickdar, in examining these instruments, Mr. Barrow walked into the observatory uncalled for by me, and with his hat on in my presence, took up a seat on one of the boxes, and remained sitting there with his hat on the whole time, for upwards of 2 hours"[3].

Barrow answered with a defiant note "that in the season 1837–38...not only your assistants wore their hats, but smoked cigars in your presence, and at this time of the year it is hardly possible to remain in the observatory when the apertures are open without some kind of [covering] on the head. And, with reference to my being in the observatory uncalled for, ... I had attended there daily, ... and I am sure you will do me the justice by admitting that, generally speaking, I have never evinced any great anxiety to obtrude myself into your museum.

"Such is the present state of my health that I am very desirous of returning to Calcutta and, should I not get better, eventually to England[4]".

Barrow's presence in camp was obviously of no further value. The circles were now complete, except for the division of the new horizontal plates, and this Barrow definitely refused to have anything to do with, so Everest ordered him to Dehra to await orders from Calcutta;

"As you have decidedly refused to obey my positive order, without assigning any reason...but... ill-health, totally unsupported by medical certificate, and at variance with all outward semblance—and it is totally impossible that I can permit such...flat contumacy and rebellion—... I have therefore to desire that you proceed immediately to Dehra Dun"[5].

Reporting to the Town Major at Calcutta, Barrow was discharged from the day of his arrival, 19-4-39, and left for England shortly after [124, 134, 436].

Everest was greatly relieved by his departure; "The whole of this affair caused me a great deal of uneasiness, for I had every inclination to be friends and oblige Mr. Barrow. I had first introduced him to the notice of the Court of Directors, and obtained his nomination. I had a high value for his skill as a workman, and was quite ready to conciliate him by any sacrifice consistent with propriety"[6]. There was obviously no hope that Barrow would ever work for Everest; they were completely incompatible [435].

On his return to England, writes Walker, Barrow "set up a manufactory of scientific instruments in London. In 1845 he constructed...two 24-inch theodolites for this Survey. ... His latest work for this Survey was the construction in 1863 of three sets of portable magnetic instruments, ... under instructions from General Sabine and the Director of the Observatory at Kew"[7].

The Science Museum at South Kensington holds a "transit theodolite by Henry Barrow & Co., ... 6-inch vertical & horizontal circles, very finely graduated on silver to 10′ of arc, and reading by vernier and microscopes to 10″"[8].

When he was elected to RAS. Barrow was residing at 26 Oxendon St. and was later at Charlton, near Woolwich; he died at Westfield near Bexhill.

BATTEN, John Hallet(t). BCS.
b. 5–5–1811. d. 14–7–86.

Writer, 30–4–29 ... ret. as Comnr. Agra, 3–3–66.

Son of Rev. Dr. Joseph and Catherine Batten of Haileybury.

m., before 1847.

ed. Charterhouse 1825–30, and Trin. Coll. Camb.

1835–45, Asst. Comnr. Kumaun; 1850, Comnr.

FRGS., 1866.

After Herbert's death discovered his rough journals on geol. svy., and prepared them for pubn. by ASB. with sketches of the route beyond Milem [III, 208, 209 ns. 1, 2, 457].

1846, as Asst. Comnr. and SO. Kumaun, prepared map, MRIO. 25 (15), *Kamaoon & British Garhwal*, scale about 8¾ m. to inch, with panorama of hills and snow peaks, peak numbers corrd. with these of Webb's map [III, pl. 6], but heights differ, eg. Trisul, XII, 23,203 feet—Nanda Devi, XIV, 25,669. Shows iron and copper mines nr. Almora, and heights—not given by Webb—of Fort Moira (Almora), 5,500 feet, and lake at Naini Tal, 6,200 feet.

Map not based on Webb; names quite different, as also twists of rivers, their tributaries, and general shape of hills; bears Batten's autograph.

BAYFIELD, George Thomas. Mad. Med.
b. 5-8-06 d. Gauhāti 9-9-40.

Asst. Surg., 20–9–28.

Crawford (318); Griffith (64–144).

DDn. 391, M 422; Dec. 1836, deputed by Resdt. Ava to meet Hannay and Griffith on Assam–Burma frontier to discuss release of Assamese held captive by Kachins. Met them on Patkai Range, 5–3–37, returning Ava 15th May. Journal of route with map [265, 440].

Auth. of *British Political Relations with Ava*, Calcutta, 1835.

1839, pol. duty, Rangoon, under Resdt. Ava.

BECHER, John Reid. Ben. Engrs.
b. 3-7-19. d. 9–7–84.

2/Lt. 11–12–37 ... Col. 13–10–63; ret. 1866; Gen. 29–11–78.

bro. to Septimus (*inf*).

CB. 1860. Conolly (84/197).

MRIO. Misc., plans and sections Ghazni, with Army of Indus, 1840.

1846–7, in ch. trans-Sutlej rev. svy.

1853–9, DC., Hazāra; 1864, Comnr. Peshāwar.

BECHER, Septimus Harding. Ben. Inf.
b. 15–7–17. d. 23–11–1908.

Ens. 27–8–34 ... Gen. 22–1–89.

Son of George Becher (1780–1837), Ben. Cav., and Harriet Geldart Barclay, his 2nd wife; bro. to John (*sup*).

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[1] DDn. 302 (152), 16-1-39; 350 (15), 17-1-39. [2] ib. (18), 23-1-39. [3] ib. (19–21), 22-1-39. [4] DDn. 302 (155), 24–1–39. [5] DDn. 350 (23), 28–1-39. [6] DDn. 344 (108–84), 3-8–39; para 134. [7] *GTS.* II [53 n.; appx. 2 (15)]]. [8] Lancaster-Jones.

m., Chelsea, 15–5–49, Augusta Emily, dau. of Augustus Prinsep, BCS.

ed. Addiscombe. Hodson, I (118).

MRIO. 170 (46), survd., 1838, part of Kumaun, including Almora and Kāli R. [209].

1839, actg. Adjt. Kumaun local batt.; Feb. 1841, PWD. Kumaun.

BEDFORD, James, [III, 422–3] Ben. Inf.
bapt. 8–3–1788. d. 31–3–71, aged 83.

Ens. 29–3–10 ... Bt. Maj. 28–8–38; ret. 1–11–43;
Hon. Lt Col. 28–11–54.

Son of John Bedford, of Acton, Middlesex.

m., Meerut, 20–9–28, Jane Helen, dau. of John Troup, of Nairn; she d., Allahābād, 18–9–36. A nat. son, also James, was appd. to Midnapore Rev. Svy. in 1838, as Asst. Rev. Survr. on Rs. 250 pm., and in 1840 tr. to ch. of rev. svy. lower Assam [202–3, 394–5, 399]; pr. father also to James B., river survr.

Hodson, I (121).

27–11–21, appd. asst. rev. survr. Morādābād, and promoted Rev. Survr. Sahaswān 19–12–22 [III, 153, 332].

1824–26, Burmese War, on mil. svy. Assam—turned back by Abors at Pasighāt—reached Brahmakund [III, 54–5].

Jan. 1827, resumed ch. rev. svy. Sahaswān [III, 154; IV, 321, 362].

1831, declined appt. to GTS.; "I have never conducted any trigonometrical or geodetical survey. ... I have some knowledge, however, of the principles on which they are carried on, founded on general reading and a former course of mathematical study, comprising the elements of Euclid...—plane and spherical trigonometry from Keith—and a partial acquisition of algebra from Friend and Bonicastle[1], which has not been followed up. ... I have paid some attention to practical astronomy. ...

"Feeling myself most conversant with the duty on which I have been so long employed, I should prefer...the superintendence of a Revenue or District Survey"[2] [208, 353].

BGO. 93 of 11–6–32, appd. to succ. Herbert as DSG. of Bengal and Supt. Rev. Svys., though Everest would have preferred an officer of his own choosing [7, 314, 316–7, 320–1, 324, 345, 362, 474]. Handing over ch. of Sahaswān rev. svy. he took up duty at Allahābād about 10th Sept. 1832. His elder dau. died shortly after, and he took two months leave to escort wife and yr. child to Calcutta, as both were sick and ordered to Europe. He had, moreover, lost "the whole of his camp equipage, besides other valuable property" by the sinking of boat off Fatehgarh during the rains, and was granted no compensation. In addition to these misfortunes he refers to "heavy pressure of commercial failures"[3]. The rev. svy. conference had to be postponed on account of this leave [211–3, 321].

The re-organization and expansion of the rev. svys. resulting from the Allahābād conference entailed heavy work, and under pressure from the Rev. Bd. he had difficulty in maintaining the high standard of prof. accuracy he desired. The Board differed from him in many occasions regarding the merits of individual officers. He was disgusted when Merttins Bird went behind his back to consult a junior officer, Henry Lawrence, regarding conduct of the svys. [148, 179, 216–7, 224, 230, 321–2, 345–6, 363].

He was glad, therefore, to be deputed to Calcutta at the end of 1837 to advise on rev. svys. of lower Bengal, and still more so when tr. was made permanent. Arrg. Calcutta 4–1–38, he was, from Oct., given ch. of SG.'s offices in addition to rev. svys. [8, 129, 139, 179, 214, 324–5, 393, 436]. Though working loyally to carry out SG.'s wishes, had disputes with De Penning regarding division of duties, and unhappy letters with Everest up-country [325, 430–1].

Did valuable work in ch. of drawing office, but refused to join the so-called "Survey Committee" set up in Calcutta by the GG., Lord Auckland, feeling, quite rightly, that it was absurd to join as the single technical member, with the risk of being constantly overruled on prof. matters which rightly pertained to the absent SG. He was supported by Everest, and eventually by Directors, who ordered dissolution of the com. [11, 120, 288–9, 298–302].

A good administrator and experienced surveyor, he maintained high standard of efficiency, which eventually won Everest's cordial respect [250–1, 325]. He was however much happier with the Rev. Bd. LP., which greatly appreciated his close control of their svys., and his full reports [148, 203, 207–9, 322–3, 348, 365, 368].

1842, applied to AG. at Simla for leave to retire; "Having now nearly completed 33 years service in India without furlough, it is my wish to retire from the 1st January next... on the pay of a full Colonel, agreeably to the modified Pension Rules dated September 1837, ... General Orders dated 17th January 1838.

"A certificate of no demands from the Presidency Pay Master was forwarded by me to the Accountant General on the 7th ultimo, but so much delay has occurred with that office in effecting an adjustment of outstanding accounts for instruments at my debit, that I...solicit His Excellency's permission to be allowed...to submit my application...through the Assistant Adjutant General...at the Presidency"[4] [320].

The certificate of "no demands" was received the following week "sooner than was expected", and nothing interfered with his sailing towards the end of Jan. 1843, after more than 20 years continuous svy. duty [138, 250, 323, 320].

BIRD, Robert Merttins. BCS.
b. 1–9–1788. d. in India 22–8–53.

Writer, 21–7–07; Offg. Mgte. Ghāzipur, 1820; Judge, Gorakhpur, 1826–8; Comnr. of Rev. Gorakhpur Div., 1829–31; Offg. Rev. Bd. WP. 1831–2; Comnr. of Rev. Farrukhābād, 1832–4; Rev. Bd. WP. Allahābād, 1834–41; ret. in India, 28–2–42.

Son of Robt. and Lucy Bird; bro. to Miss Mary Bird, mssny. at Gorakhpur and Calcutta; cous. to Geo. Merttins Bird, BCS. (1807–34).

m., 1st, Calcutta, 21–9–10, Jane Grant, dau. of Rev. D. Brown; she d. Gorakhpur, 6–9–21, aged 29.

m., 2nd, at Cape, 2–6–25, Miss Jane Bird, dau. of Wm. Wilberforce Bird, of Cape GH.; she d., Hastings, 18–1–54, aged 54.

m., 3rd, 1–3–48, Henrietta Maria Jane, dau. of Pascoe Grenfell, MP.

DNB.; *DIB.*

Took leading part in organization of rev. svys. WP. [7]. On joining Bd. at Allahābād, "the senior member [Fane]...was a mild, intelligent, gentleman-like man, with much revenue experience and knowedge, but thrown in the shade...by a superior colleague. The junior member bore the well-known name of Robert Marttins Bird, and on him for many years the task of directing all revenue operations, and especially those of the new settlement, eventually devolved. He, indeed, was a man of no common order.

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[1] John Bonnycastle (1750 ?–1821), prof. of maths. RMA.; *DNB.*
[2] DDn. 264 (288–92), 18–10–31.
[3] BTC., 5–8–33 (34).
[4] DDn. 409 (252), 16–7–42.

"The first 20 years of his Indian life were passed entirely in judicial duties. Yet...he became during that period the best practical revenue officer in the country. ...

"From the time that he took the reins in the Revenue Department, in which he long reigned quite supreme, the whole conduct of the revision of the settlements assumed a new character. ... Allowed to select his own instruments, he usually chose young men as being...more manageable than their seniors, and less likely to be imbued with prejudices derived from the dark ages of our earlier administration. ...

"The result was that in eight years after the enactment of Regulation IX of 1833 [223], he was able to report...that he had redeemed his pledge: that the settlement...was completed, and that he was at liberty to relinquish his arduous post[1], [210, 213, n.3, 214, 216, 322]".

1837, introduced new procedure, increasing outturn of svy. parties from 1,000 to 3,000 sq. m. per annum. "After some years' trial of the surveys, their expenses were threatening their abolition. ... Mr. Bird took into council Henry Lawrence to devise a more economical survey, ...by increasing the strength of the establishments under a single head, and diminishing the details of the professional portion of the survey" [215-8, 453, 471][2].

JASB. VIII, 1839 (598) sketch of camel cart, a four-wheeled buggy with wheels 6 feet diameter "in which Mr. Bird of Allahābād had recently made an official tour of 2,000 miles in Upper India" [321].

BLAKE, Muirson Trower. Ben. Inf.

b. Berhampore, 24-11-09.
d. Gwalior, 11-6-57, kd. by mutineers.

Ens. 7-1-27 ... Capt. 18-7-48; Bt.-Maj. 20-6-54.

Son of William Blake, Ben. Inf. [III, 425], and Mary Anne Woolsey his wife.

ed. Harrow, 1820-4.

m., Lucknow, 9-3-31, Charlotte Adeline Judith, dau. of Mordaunt Ricketts, BCS., Resdt., Lucknow.

Hodson, I (163).

1837-8, escort comdr. and survr. on Pemberton's Bhutān mission [203-4]. Frequent mentions in narrative. Griffith (205-312); 22-1-38, Dewāngiri, "Yesterday evening Mr. Blake's khidmutgar died rather suddenly...owing to over-loading the stomach with radishes".

31-1-38. "Reach Roongdoong. We put up in the house of the...headman. ... During our stay...he invited Pemberton and Blake to shoot pigeons; the poor man thought they would not be able to hit them. On finding out his mistake, he put an end to the sport".

They stayed from 9th April to 9th May at Punakha, the capital town, and re-entered Bengal at Buxar, 18-5-38.

Blake's svy., MRIO. 91 (4-12).

1842, 2nd in comd. Gwalior Inf.

BOILEAU, Alexander Henry Edmonstone.
Ben. Engrs. [III, 426].
b. Calcutta, 3–2–07. d. Cawnpore, 30–6–62, of dysentery.

2/Lt. 17-6-24[3] ... M Gen. 18-10-60.

Son of Thomas Boileau, solicitor and notary public, Calcutta, and Leah, dau. of Col. Jessup of USA., his wife; bro. to John Theophilus Boileau [422].

ed. Addiscombe, 1823-4.

m., 1st, Agra, 3-2-34, Charlotte, dau. of Wm. Hanson; and sister of his bro.'s wife; she d., Barrackpore, 29-4-40, aged 26.

m., 2nd, Paignton, Devon, 5-9-50, Matilda Grace, dau. of Alex. Tovey, HM. 20th Foot; she m., 2nd, Lt.-Gen. A. T. Cadell, Mad. Art.

Boileau; Conolly (87/135); Hodson, I (171-2); III (746) IV (630); Colesworthy Grant, portrait [pl. 10].

1827-8, traverse svy., Allahābād to Cawnpore [III, 24-6]; 1828-32, from Agra and Delhi to Bharatpur [III, 26-7; IV, 2, 3, 271-2, 351, 353, 360, 448]. March to Sept. 1831, svy. of Bharatpur interrupted by duty with Resdt.[4] on "enquiry into the present state of the Shekawuttees, and other hordes of robbers who are to be found in the territories of Jeypoor, Bikaneer, Joudpoor, &c."[5].

1832, after meeting GG. in camp at Bhasāwar, near Jaipur border, in March, marched S. from Agra to reach Sironj 24-4-32, being deputed by SG. to lay out S.ward extension of Great Arc. Thwarted by persistent hot weather haze, he abandoned work without having accomplished anything of value, and reached Agra, 18th July [4, 14, 23, 77, 354].

Oct. 1832, directed to reconnoitre N.wards from Agra to Delhi, meeting Everest for fresh instructions during April. He then continued traverse svy. across Jumna plain through Meerut and Muzaffarnagar, reaching Sahāranpur 6-8-33, a very heavy task for the hot weather [15, 24, 25-6].

18-8-33, "Saharanpoor. I left this place by dawk at about 5 p.m., leaving the camp standing, and proceeded to join the S.G.'s hdqrs. at Misoorie. On Monday, August 19th, arrived at Rajpoor (at the foot of the hills and 7 miles beyond Dehra) at about 8 a.m., and reached the S.G.'s office at "The Park" the same day, remaining there until the end of the month[6]" [105].

2-11-33, with SG.'s party that left Mussoorie for Agra for the detailed selection of stations N.wards to the Himālaya. Though new to trig. svy. made himself useful in organizing supplies and personnel, and was of considerable help in working out details of ray-trace method [26-7, 29, 31, 34-6, 79, 355; 411-2].

Did not escape Everest's sharp rebukes that were showered on officers and appces. alike; "It was ill-judged sending the artificers to Biana; ... I am seriously in want of their services. ... I beg you will exert yourself to ascertain where the men are gone, what has become of them, and how they are to be brought to join my camp. ...

"The inconvenience is such as the Superintendent ought not to be subjected to. ... Yesterday, ... in order to look through the telescope...my Chief Civil Assistant and myself were obliged to stand on a pile of camel trunks raised pair by pair. ... To take the instrument out of its box and put it on its stand, to level it, observe with it, and afterwards replace it in the box, were attended with considerable hazard, ... and great pain and annoyance to me personally, because, being the only person whose legs and arms were sufficiently long, the whole brunt of the observations fell upon me. ...

"As I look upon all this inconvenience as attributable to the badness of your arrangements, and...want of judgement, ... I look to you...to do your utmost to remedy the mischief[7]".

It is surprising that he found opportunity for courtship and marriage in the height of a most strenuous field season. He writes to Everest from Delhi, 30th Jan.: "I arrived at

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[1] *Rev. Svy. (India)*, 1853.

[2] Edwardes (81-2).

[3] 1st. Ben. Engr. to receive comn. as 2/Lt. instead of Ens.

[4] Abraham Lockett [II, 417], AGG. Bharatpur, 1827-33.

[5] MRIO. M 317, 31-3-31; 10-9-31; DDn. 266 (123), 11-11-31.

[6] MRIO., M 529.

[7] DDn. 321 (83-5), 27/29-12-33.

> this place yesterday evening from...a circuit of about 140 miles. ... The hill station at Kasum is 130 feet high, but will not form good angles with Meoli and Delhi. ... Mohammadpoor furnishes only a mosque upon a sandhill. Nujufgurh has a gateway of masonry 32 feet high, but is built on a flat plain, and would require extra brickwork...for the accommodation of the 18-inch instrument. Bahadurgarh also lies in a flat, but has a high gateway...which overlooks the Nawab's zenana [103], and would require brickwork as the roof is rickety. ...
>
> "This evening I am to start by dak from Delhi, and hope to be at Agra on the 1st of February, leaving cantonments again on the 3rd proximo [date of marriage] in progress towards the headquarters G.T.S."[1].

Spent rains of 1834 in Mussoorie, and in Sept. joined the Shekhāwati fd. force, being attd. after close of mil. ops. to pol. mission to w. borders of Rajputāna bringing back much valuable svy. [271–3]. He writes to AGG. in Jaipur August 1835 ;

> "As it will take me several weeks, or even months, to complete the various papers, ... and as I have already been more than ten months absent from my home which I quitted at one day's notice in...September 1834, I should be truly grateful if you would permit me to compile my report and finish my maps at the station of Futtehgurh, where my family now resides[2]".

Dec. 1835, after finishing off his Shekhāwati work at Fatehgarh, took ch. of Parasnāth series at Midnapore, 9–12–35, bringing party into recess quarters at Bānkura 22–5–36, with himself, his Indian doctor, and half the est. down with fever. Next season worked through E. Singhbhum towards Mayurbhanj, followed by six mo. leave on mc., and sea voyage to China, from 28–7–37. Whilst at Calcutta stayed at Benton's Hotel [60, 160, 188, 316, 355–6, 375, 408].

23–12–37, resumed ch. of Parasnāth series, but resd. 24–12–38 to become Supt. Canals and Agent for Iron Suspension Bridges at Calcutta, "my health having suffered so much from eleven years constant wear and tear in Survey Department, and particularly from the last three seasons' employment in the junguls west of Midnapoor [175–6, 367].

> "The prospect of obtaining a quiet situation in Calcutta, instead of continuing to kill myself by inches in the junguls of Mohurbhunj, has induced me to write the accompanying letter. ... My triangulation is brought down to within 27 miles of two of Lieutenant Buxton's stations [60]. ... Should I not succeed in obtaining the appointment, ... I will of course resume my duty in the junguls, coute qui coute[3]".

Congratulates SG. on the progress of the Mussoorie–Rajpur road ; "I am happy to hear that such great progress has been made in cutting the 'facilis descensus' towards Dehra. Truly I ought to remember every nook of it, from "Windy Corner' to the awful *panchi* near Grey-nose, where for once in my life I actually looked disconcerted. ... Mrs. Boileau and the child are quite well[4]".

Amongst duties at Calcutta was given ch. of the MIM's. workshops, thereby relieving DSG. from that responsibility [129, 335, 430], and holding the post till 1843.

Though acknowledging his general technical ability and zeal, Everest did not otherwise regard Boileau as suitable for GTS. ; he had been disappointed with his failure on the Sironj–Agra recce. of 1832 [23], and with his "want of system" on the Parasnāth series [355].

July 1843, marched through the hills, Simla to Mussoorie, to stay with Everest at Hāthipaon. 1844, actg. Supt. Delhi canals ; 1845–6, on Railway Com. with F. W. Simms ; 1854, SE. Agra.

Pub. in Calcutta, 1845, *Miscellaneous Writings in Prose & Verse*, which include a string of doggerel verses on the life of a survr., of which the following are fair samples ;

...
How can a lady understand
The odd delight I feel
Theodolite to take in hand
While following the wheel ?

...
My false horizon when I view
So many stars I see,
No girl need fix, however true
Or false, her eyes on me.

BOILEAU, John Theophilus. Ben. Engrs.

b. Calcutta, 26–5–05. d. 7–11–86.

Ens. 19–12–20 ... Col. 1–5–55 ; ret. 10–3–57 ;
Hon. M Gen. 29–5–57.

bro. of A. H. E. Boileau [*sup*] and 1st cousin of J. P. Boileau, both the gunner and the sapper [III, 426].

ed. Addiscombe, 1819–20 ; with Trig. Svy. GB., and Chatham ; arrd. India, 22–9–22.

m., Agra, 23–4–29, Anne, dau. of William Hanson, and sister to Alexander's 1st wife.

FRS. 1840 ; FRAS. : Conolly (87/126).

RAS. (*mn.*), XLVII, 1887 (133–5) ; *RS. Progs.*, XLII, 1887 (i–vi), ob. by Henry Yule ; Colesworthy Grant, portrait in uniform with scientific insts. in background, from *Indian Rev.*, of Oct. 1840 ; *IL News*, 20–11–86 (550), with portrait ; portrait by Sidney Hodges at Soldiers' Daughters' Home ; Hodson, I (173–4) ; *JASB.*, II, 1833 (251), describes sundial in court of Moti Masjid, Agra Fort, 21–3–33.

1833, Ex Engr. PWD. & bkmr., Agra and Muttra ; helps Alexander frequently during Gt. Arc recce., 1833–4 [29].

1836, issued in India litho. edn. of *Traverse Tables*, pub. London 1839 whilst on furl. 1837–9, under title *A new and complete Set of Traverse Tables, ... to every minute of the quadrant, and other Tables useful to the Surveyor and Civil Engineer*.

In copy of later edn. is note in his own writing, 12–11–80, "These Traverse Tables were prepared to facilitate the computations of the areas of village lands by the officers of the Government Revenue Survey, and have gone through several editions". They were officially adopted for the NWP. rev. svys. and used in India ever since[5] [232, 239, 439].

Other tables were issued by him in 1844–5 "for determining the elastic force of Aqueous Vapour in the Atmosphere" & "of Astronomical Refraction"[6]. Those printed by Craven have preface sd. J.T.B., Ambāla, 20–5–51, [118].

CD. to B. 3–10–39 ; Directors send to India "M.S. Map of Rohilkund, ... compiled in this country [England] by Captain J. T. Boileau. ... We shall reimburse to that officer the amount paid by him for the draft of the fair copy, ... viz., £45–1–7[7]" ;

Whilst on furl., deputed to Dublin for instn. from Dr. Lloyd in magnetic obsns. ; on return to India appd. GO. 5–8–40, to start magnetic obsy. at Simla, holding ch. till it was closed down in 1845 [117–8, 439].

From 1848, SE. Ambāla, Meerut, and then CE. at Agra from 1854. At Ambāla compiled PWD. standing orders into *Boileau's Code*.

Yule writes of him ; "His exuberant spirits, ... often showing themselves in proceedings of an eccentric character, made him better known...than his intellectual gifts or practical accomplishments. ... His sayings and doings were the subject of many widely current anecdotes".

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[1] DDn. 331 (21), 30–1–34 ; xvi (19). [2] ib. (51–2), 12–8–35. [3] to SG. with letter to PS. to GG. ; DDn. 370 (43–4), 26–8–38. [4] ib. (44–5), 2–10–38. [5] Feb. 1842, O'Donel sends DSG. details of errors found in Boileau's *Tables*. [6] *JASB.* XIII, 1844 (135–70) ; XIV, 1845 (1–9). [7] MRIO. 28 (22–3) ; "compiled for the Military Board of Bengal".

His 30 years of retirement were usefully employed. "The most energetic of vestrymen at Kensington. Zealous member of the Volunteer body, ... insisting on carrying his rifle as a private in the ranks. On the Council of the Royal Society, and acted as auditor of its accounts. ... Chairman of...the Soldiers' Daughters' Home at Hampstead, and that of the Officers' Daughters' at Bath. ... He would sometimes walk the whole distance [to Hampstead] from his residence at Notting Hill before breakfast" ; *RS Procs.*

BONTEIN, John. Ben. Inf.

b., 2-2-09. d. 17-8-78.

Ens. 17-8-26 ... Lt Col. 26-1-61 ; ret. 8-3-61.

Son of Edward Trant Bontein, Capt. 92nd Highls. and Anna Maria, his 1st wife, dau. of John Sims. ; neph. of James Bontein (1788-28), Ben. Cav., Hodson, I [178] ; and pr. kin to Wm. Bontein, at Kidderpore Orphanage 1839-40 [300].

m., Agra, 21-9-35, Elizabeth Mary, dau. of H. C. Barnard (1786-1858), Ben. Inf. ; father of John Sims Bontein, RM, whose only dau., Ethel Mary, m. L. F. Everest, eldest son of George Everest, SG. & STS. [442].

Hodson, I (179).

July 1838 "absent from his regiment for a considerable period on medical certificate", was recdd. by Everest as asst. in SG.'s fd. office, but had to wait owing to the number of subalterns of batt. already absent on staff duty. Two months later Everest reported "that for the last month and upwards Lieutenant Bontein has been very regular in his attendance at my office. ... A more eligible person will hardly be found". Under GO GG., Simla, 9-10-38, appd. "Assistant in the office of the Surveyor General of India, on a salary of...200 rupees per mensem" [252, 325-7, 329, 436].

April, 1840, asked for 12 mo. leave, having been "for a long time past...seriously affected with some internal organic disease, and though very anxious to attend to his office duties has been utterly unable to do so". As Govt. refused to pay salary to both Bontein and his substitute, he had to forego this leave, as he could not afford to lose the salary, being "burdened...with a wife and several children [329][1]".

BGO., 13-10-42, ordered "to join...corps in the field", against which Everest made vigorous protest ; C-in-C. replied that the SG.'s "wishes will be held in recollection", and Bontein was released to rejoin SGO. at Dehra on 4-3-43. GG., however, was not convinced of SG.'s need, and declined to confirm his return[2]. Bontein rejoined the 37th Regt. NI. at Allahābād[2], and took furl. in Dec. 1844 [357].

In later years Bontein spent much time in his small house at Rock Cottage, Mussoorie, just south of present site of the Library. Jan. 1852, SSO. Landour.

BRIDGMAN, Perceval. Ben. Art.

b. Barbados, 26-9-11. d. at sea,
17-4-35, in *City of Edinburgh*.

2/Lt. 12-12-28.

Son of John Bridgman of Versailles and Catharine his wife.

m., Agra, 10-10-34, Jane, dau. of Maj. R. J. Debnam, HM. 13th Lt. Inf.

ed. Addiscombe, 1837-8. Hodson, I (202).

Dec. 1831, on meast. Calcutta base-line [49-50] ; appd. to GTS. under BGO. VP. in C. 12-3-32, [352-3]. Before he could join, however, granted leave on mc. to China, Aug. 1832 to 31-5-33. Further delayed by sickness in India, did not join Budhon series till April 1834 for work in Gwalior State. Married six mo. later.

Oct. 1834, tr. to ch. Parasnāth series, Midnapore, for revision of Western's work. "This promising young officer's health was too delicate for the fatigue and exposure, ... and he was necessitated to apply for sick leave to proceed to England and died on the voyage"[3]. Furl. on mc., 27-2-35 ; Will dated Midnapore, 3-2-35 [3, 60-1, 367].

BRIND, James. Ben. Art.

b. 10-7-08. d. 3-8-88.

2/Lt. 3-7-27 ... Gen. 1-10-77.

Son of Walter Brind, of Paternoster Row, London, ribbon manufacturer and silk merch.

m., 1st, Meerut, 20-4-33, Jane, dau. of Joseph Conway Waller ; she d., Ambāla, 29-12-49.

m., 2nd, Simla, 11-9-52, Mary Georgina, dau. of Benjamin Carter ; she d., Peshāwar, 2-3-54.

m., 3rd, Ootacamund, 24-10-61, Georgina, dau. of Rev. H. G. Philips, vicar of Mildenhall ; she d., Simla, 1862, kd. by fall with her horse down the *khud*.

m., 4th, 1867, Jane, dau. of Rev. D. H. Maunsell, of Ballyriggan, co. Dublin ; she d., 6-11-68.

m., 5th, 16-10-73, Eleanor Elizabeth Lumley, dau. of Rev, H. T. Burne, of Grittleton, Wilts ; she d., Bath, March, 1924.

CB., 1858 ; KCB., 1869 ; GCB., 1888. *DNB.* ; *DIB.* ; Hodson, I (205) ; Condon. (286).

GO. GG. in C. 29-2-36, placed at disposal of Agra Govt. as asst. rev. survr., joins Wroughton's svy. Aligarh ; April, to ch. Azamgarh (E) svy., relieving Terranneau ; to Gorakhpur (EC.) now Basti Dist., 1837 ; reverts to mil. duty for Afghān War, Oct. 1838 [215, 225, 362, 368, 390, 470].

BROADFOOT, James Sutherland. Ben. Engrs.

b. 29-8-16. kd. in action, 2-11-40,
Parwandarah, nr. Kābul.

2/Lt. 12-6-35.

Son of Rev. William Broadfoot, of Kirkwall, minister of a Scotch ch. in London ; bro. of Wm. Broadfoot, also Ben. Engrs.

ed. Westminster from 1827 ; *OW.*, I (123). Addiscombe, 1833-5. Conolly (89/190) ; *Punjab Inscpns.* (37-8).

1839-40, svy. in Afghānistan ; survd. route Ghazni to Dera Ghazi Khan [282, 283, n.6, 284] ; Holdich writes, "Previous to his start on the Gomul reconnaissance, Broadfoot had the opportunity of reconnoitring much of the country to the south of the Ghazni bordering the Kandahar-Ghazni route. ... He took his bearings with the prismatic compass, and he reckoned his distances by the mean values.. from three men pacing. ... Hardly able to leave his tent in spite of his disguise, but his clear description of the ground he passed over, and the people he passed amongst...[establishes] the practical value...of that important line of communication.

"Broadfoot's khafila lost no less than 100 men in transit"[4].

BROOME, Arthur. Ben. Art.

b. 7-2-10. d. at sea, 27-3-71,
between Bombay and Suez.

2/Lt. 13-12-27 ... M Gen. 6-3-68.

Son of John Broome, of Gt. Marlow, Bucks.

m., Calcutta, 7-4-40, Julia Leonora, dau. of Robt. Kent (1791-1848), Ben. Inf.

ed. Addiscombe, 1826-7. Hodson, I (218).

21-8-38 ; ADC. to GG. ; 1838-9, with Army of Indus *IO. Cat.* (453), 1839, fair drawing of plan of Sukkur with pencil sketch of general view [282 n.3].

June 1839, with Alex. Cunningham, survd. hills N. of Simla, returning alone, July-Aug., via Spiti and Yunam Chu [269, 360, 428].

1842, Asst. Sec. to Mil. Bd., Ft. Wm. ; member of ASB. ; 1846-64, Supt. Cossipore Foundry.

Auth. of *Rise...of the Bengal Army*, Calcutta, 1850 [I : xvii].

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[1] DDn. 402 (21), 16-6-40 & (52), 23-6-40 ; 403 (159), 8-6-40. [2] from AG., 22-4-43 ; DDn. 401 (258). [3] Report, 21-8-39 para. 10. [4] Holdich (471-2).

BROWN, William [III, 427]. Ben. Inf.
b. 22-12-1795. d. Sukkur, 11-9-45, on mil. service : unm.

Ens. 5-6-15 ... Bt. Maj. 23-11-41.

Son of Andrew Brown, writer, co. Ayr., and Margaret Gemmil, his wife.

Hodson, I (228).

1822, appd. Asst. Rev. Survr., Delhi [III, 156, 333]; 1826, to upper *doāb*. Took leading part in empt. Indian survrs. on rev. svys. of w. Provs. [III, 157-8, 162-3 ; IV, 211-2, 231, 402]. Ch. of svys. Bulandshahr 1829-32 ; Meerut & Sahāranpur, 1832-6 [pl. 13] ; Hissār & Delhi 1837-8 ; Dehra Dūn, 1838-9 ; Cis-Sutlej, 1839-41 ; Mussoorie & Landour, 1841-2 ; reverted to mil. duty, Oct. 1842 [214-5, 218-21, 229, 232, 234, 362-3, 387-8, 391 ; pl. 17].

1844, re-empd. on rev. svy. Kaithal[1], 40 m. w. of Karnāl ; writes to SG. ; "The Revenue Survey has been reduced to a low ebb. The department was broken up, and individuals of upwards of 20 years in the service were sent away without even thanks. ... The only advantage I have for my pains and trouble... is the reflection that I have performed my duty, while another [Wroughton] has reaped the advantages in being appointed Deputy Surveyor General, which I humbly submit was due to me"[2].

Though Brown was senior in mil. rank to Wroughton, the latter had longer service as survr. [III, 333 ; IV, 7, 208, 322, 363, 368, 476].

JASB., VII (429) ; article on "ancient temple and famous ship model at Hissar"[3].

1845, joined mil. operations on Sind frontier, where he died.

BURNES, Alexander [III, 431]. Bo. Inf.
b. 16-5-05. kd., Kābul, 2-11-41.

Ens. 6-6-21 ... Bt. Maj. 23-7-39.

Son of James Burnes, Writer to the Signet & Provost of Montrose.

ed. Montrose Academy. Kt. Bach. 6-8-38.

DNB. ; *DIB.* ; *Ency. Brit.* ; *Bokhara* ; Burnes ; *Indian Officers* ; *Oriental Club* ; *Pioneers in India*, ch. XII ; Holdich ; Davis (23-5) ; *JRGS.* XII, 1842 (xxxvi-vii).

1823-9, on staff & pol. duty in Cutch, making various svys. [III, 131] ; 1829-30, on svy. in Rājputāna [III, 132-3 ; IV, 242].

At end of 1830, given ch. of mission from King of England to Ranjīt Singh at Lahore, with gift of 4 dapple-grey dray-horses, with another from GG. of barouche or coach. He was to travel up the Indus, making a geogl. report. With John Leckie, left Māndvi 21-1-31 in fleet of 5 country boats. After delay and difficulty in getting passes from Mirs of Sind, made their way up Indus, Chenab, and Ravi, to enter Lahore on 18th June [10, 242-3][4].

From svys. along Sind coast and up the great rivers, produced notable *Map of the Indus*, supported by memoir of construction [243-4, 246-7, 274].

From Lahore reported to GG. at Simla, and accd. him to meet Ranjīt Singh at Rūpar [274][5]. He was now deputed to visit Bukhāra via Kābul, to obtain infn. *re* possibility of Russian advance from that direction. Obtained services of James Gerard as survr., with muhdn. survr. from Bo. Engr. Instn., and *pandit* from Delhi named Mohan Lal [qv].

After a few weeks at Ludhiāna with Wade [III, 510], visited Delhi, 13-12-31 ; on 14th "in the evening I met the Governor General and his family who were now in Delhi. I paid my obeisance to the Great Mogul this morning [II, 380], in company with the Resident...—the 15th in descent from Timour—a decrepit, toothless old man, with a venerable expression"[6].

Starting from Ludhiāna 2-1-32, the party reached Lahore on 17th, Peshāwar 20th March, and Kābul 1st May. After many adventures they reached Bukhāra 27-6-32, where they stayed till 21st July, when they left for Meshed, Persia, which they reached 14-9-32. Here Burnes branched west to the Caspian, leaving Gerard and Mohan Lal to return via Herāt and Kandahār [VII, 10, 274-6].

From the results of this remarkable journey Burnes produced a *Map of Central Asia*, pub. by John Arrowsmith, and his *Travels into Bokhara*, pub. in 3 vols. in 1834, extracts from which are here given with others from Mohan Lal's *Tour through the Punjab, Afghanistan, Turkistan* [277, 290, 292-4, 401].

After leaving Lahore the party abandoned all comforts, and lived so far as possible like the people of the country.

"We had no tents to shield us from the rain" writes Mohan Lal "we had no beds to sleep on, but the bare ground. At night I was quite astonished to see Mr. Burnes and Dr. Gerard sitting on the ground".

13th Feb., reduced heavy baggage, and sent back servants ; "The Durani tribe, seeing a multitude of servants with us would think us to be rich men, and plunder us at night".

19th Feb. "The Chief of Ram Nagar...brought some wine made in the country. It was accepted and distributed to the people, as Mr. Burnes had not tasted wine since he left the presence of Runjit Singh, with whom Messrs. Burnes, Gerard, Wade, and Murray, gave way to the more noisy pleasures of wine and festivity".

7th March, reach Rāwal Pindi. 8th. "We halt here to reduce still more of our baggage. The load of two mules we kept, and all the rest we threw away. We put on the Persian habit, and pretended to counterfeit the persons of Duranis, but this imposition was not calculated to bear close inspection.

"Mr. Burnes altered his English name, and called himself Sikandar Khan, and I was named Hasan Jan. ... We tied our cooking pots on our horses' backs".

14th, camp on Indus. "Mr. Burnes and Dr. Gerard... forded the Indus on elephants. There happened a melancholy accident in this excursion. Seven horses with their riders were swept away by the impetuous torrent, two of which, and one man, were consigned to a watery grave".

20th March, reach Peshāwar. 11th April, Burnes and Mohan Lal both sick. 19th April, left Peshāwar. Travelled along Kābul R., rejoining Khyber road at Dhakkar.

25th April, reach Jalalābād.

1-5-32, arrived Kābul. Met Rev. Joseph Wolff, "a zealous missionary" arrived from Bukhāra. "His sole object is to discover the lineal descent of the Jews. Had been robbed and walked naked into Kabul"[7].

Fanny Parks met Wolff at Allahābād, Feb. 1833 ; "A German Jew converted to the faith of Christ. ... He roams about the world in search of the lost tribes of Israel. ... When at Simla, he was with Lord William Bentinck, and preached every Sunday in the presence of the Governor General[8]".

18th May, left Kābul with armed guard, travelling through Hazāra country to w. Crossed Hajigak Pass

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[1] Small Sikh State, recently lapsed to British Govt. [2] DDn. 454 (28-40), 11-2-44. [3] Markham (245). [4] *Bokhara*, I (1-44). [5] MRIO. 9 (4), 1-inch sketch of the 2 camps on either bank of Sutlej, with bridge of boats between. [6] *Bokhara*, I (179-81). [7] Mohan Lal (17-58). [8] Parks, I (268).

12,400 ft. above sea, below Koh-i-Baba [pl. 16]. "The passage was not achieved without adventure, for there was no road to guide us through the snow, and the surveyor Mahomed Ali, along with his horse, went rolling down a declivity, one after the other for about thirty yards. ... It was impossible to resist laughing. ... He, a round figure wrapped up in fur, and far outstripping his long-shaped animal, which made deeper indentations in the snow"[1].

On 23rd they reached Bamiãn, "celebrated for its idols and excavations". The caves extend some eight miles through the valley. The two colossal figures are one male, the other female.

30th May, reach Khulm. "We feared much", writes Mohan Lal, "from Mir Morad Beg, the chief of Qunduz[2], who behaved very ill to Mr. Moorcroft [III, 480], and seems to treat every man of his country in the same manner [270]".

2nd June. "Chiman Das...took me to a solitary room, and slowly asked me whether these Farengis are come to see the country, or in reality on the route to Europe. If the former case was true, ... he should advise the Diwan Begi to take a considerable sum of money from them, a part of which should come into my hands.

"After a great many oaths, and by swearing on the Hindu deities, I convinced him that the gentlemen were poor, and going to their native country. ... He said to me, on account of my Brahman caste, ... he would do his best to get leave for the gentlemen without delay. ... So he started to Qunduz in company with Mr. Burnes"[3].

Burnes had a hard ride, and an awesome interview before obtaining a permit for the onward journey. "On the evening of the 2nd of June, I set out on my journey to Koondooz. I boldly denominated myself a Hindoostan Armenian. ... We entered Koondooz at nightfall, after performing a journey of more than seventy miles. ...

"Early on the morning of the 5th we set out on our journey to Moorad Beg". Backed by his escort, Burnes' disguise was accepted, and he was permitted to return. "Left Koondooz at three p.m., nor did we halt till we reached Khooloom on the following morning, worn out with fatigue after being seated on one horse for twenty hours. ... I rode the very same animal which had been given to me by the brother of the Peshawar chief, ... a horse of the same breed having formerly availed Mr. Moorcroft when he escaped to Talighan [III, 486].

"It was with heartfelt satisfaction that I again found myself with Dr. Gerard and our own party, ... the stomach refreshed by tea, the most refreshing beverage to the way-worn traveller. Among the Uzbeks we frequently lived upon it[4]".

In this country of brigands it was essential to avoid any show of comfort, and, writes Mohan Lal, 3rd June, Khulum, "Our dress and manner of living showed our poverty, and we never changed clothes till they disappeared under filth and vermin. ... Our breakfast was made on horseback, and it consisted of pieces of dry bread, cooked six or seven days, and of a bit of meat and cheese. ... Captain Burnes and Mr. Gerard used their fingers instead of knives and forks, and their hands for spoons. Our towels were the sleeves of our shirts. We combed our hair with the nails of our fingers, and brushed our teeth with a piece of wood.

"We were highly delighted to see our enterprising companion Mr. Burnes who, after an absence of six days, returned to alleviate our fears. ... Our departure was urged by every circumstance. Mr. Burnes and Dr. Gerard started early in the morning without taking any clothes and victuals with them".

10th June. "We halted at Mazar on account of the heat of the day, and put up in the same place where Mr. Trebeck died of a fever [III, 508]. I was very sorry not to meet Mr. Burnes at Mazar as he had left it for Balkh. All the property of Mr. Moorcroft was forfeited by the ruler of Mazar on the death of Mr. Trebeck [III, 487].

"11th June, reach Balkh, or Bactria. ... Captain Burnes and Mr. Gerard took an opportunity to visit the...relics of the much lamented Mr. Moorcroft. ... Mr. Burnes had delivered his passport to the Nazir to take care of it when he went to Qunduz. He asked him to return it, but the Nazir replied that it was lost. Mr. Burnes burst into a passion, and told us to be ready to fight with the Nazir with swords and pistols, but meanwhile the Nazir was informed of this, and sent us the passport immediately by his servant".

Burnes describes the crossing of the Oxus on 17th June; "We halted on the bank of the river near the small village of Khoju Salu. ... The mode by which we passed the Oxus was singular. ... We were drawn by a pair of horses who were yoked to the boat on each bow by a rope fixed to the hair of the mane. The bridle is then put on as if the horse were to be mounted. The boat is pushed into the stream, and without any other assistance than the horses is ferried directly across the most rapid channel. A man on board holds the reins of each horse, and allows them to play loosely in the mouth, urging him to swim and, thus guided, he advances without difficulty. There is not an oar to aid in impelling the boat, and the only assistance from those on board consists in manœvring a rude rounded pole at the stern to prevent the vessel from wheeling in the current, and to give both horses clear water to swim".

At Kurshee Burnes and Gerard were both laid up with fever; "Some of us had been complaining for a few days, ... and immediately on our arrival I was prostrated by a severe attack of intermittent fever. The surveyor was seized at the same time, and on the following day the doctor and two others of our party were ill. ... We must have caught the disease at Balkh, or on the banks of the Oxus. ... We adopted the usual treatment of India, taking emetics and medicine, and in my own case I followed them up with quinine, which had the most happy effect.

"In three days my teeth ceased to chatter, and my body to burn; but the doctor, who insisted in treating himself with calomel, was not so fortunate, and he did not shake off the disease till long after we had left the country.

"Our stay at Kurshee was prolonged for three or four days, during which we lived in a garden under some trees. ... It was a miserable hospital, but we quenched our parching thirst under a thermometer at 108° with sherbet of cherries, cooled by ice which we here found in great plenty. ...

"Our journey from the Oxus to Bokhara had been of a most fatiguing and trying nature. In Cabool we had been chilled by cold, and were now almost burned up with heat. ... Camels only advanced at half the pace of a horse, and we spent double the time on the march. ... The only horse which accompanied us was so completely knocked up that he fell down in several places before entering Bokhara.

"We also travelled at night, and the rest which one gets on a camel is broken and disturbed. Our water had often been bad, and our food chiefly consisted of hard biscuit"[5].

Mohan Lal takes up the tale;

22nd June. "Captain Burnes and Dr. Gerard were seized with fever, also two servants, and a tea merchant who, after lingering 8 or 10 days in Bokhara, died. Dr. Gerard—though still an invalid—and Mr. Burnes attended him at his serai, but their services were unavailing".

27th June, arrd. Bukhãra. "Mr. Burnes was...to live separate from us, and I told every one that I did not know who he was, but this secret was not long concealed". 28th. "Mr. Burnes paid a visit to Oosh Begi. ... He told us not to write while we stayed at Bokhara, as he knew well that all Europeans are in the habit of doing so, and our touching pen and ink would create a suspicion. ... On this we fixed an hour for writing at midnight, and in doing so unobserved we were successful"[1] [275].

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[1] *Bokhara*, II (156) [2] 150 m. N. of Kābul, and 15 NW. of Khanābād. [3] Mohan Lal (68). [4] *Bokhara*, II (183–98).
[5] ib. (214–27).

In Bukhāra Burnes resumed the role of a British officer travelling to Europe, and as such paid several visits to the chief minister. "I considered it prudent to acquaint him that I had a sextant; ... that I liked to observe the stars and other heavenly bodies, since it was a most attractive study. ... The Vizier...begged...that I would inform him of a favourable conjunction of the planets, and the price of grain which it indicated in the ensuing year. I told him that our astronomical knowledge did not lead to such information, at which he expressed himself disappointed. ...

"It struck me that the all-curious Vizier might be gratified by the sight of a patent compass, with its glasses, screws, and reflectors, but...that he might regard my possession of this complicated piece of mechanism in a light which would not be favourable. I produced the compass, which was quite new, and of very beautiful workmanship. I described its utility. ... He was proceeding to bargain for its price, when I interrupted him by an assurance that I had brought it from Hindustan to present to him. ... It would enable him to point to the holy Mecca, and rectify the 'kiblu' of the grand mosque which he was now building in Bokhara. ... Thus fell one of my compasses. It was a fine instrument by Schmalcalder [III, 132, IV, 243], but I had a duplicate. ... It was not sacrificed without an ample return"[2].

They spent less than a month in Bukhāra, where, writes Mohan Lal, "we are all looked on as Kafars, and were not permitted to ride. ... Like other infidels we were obliged to submit to be distinguished by a peculiar dress. This is a black cap, and a rope round the waist. Captain Burnes and Mr. Gerard suffered from the same restraint as I did, which to them must prove very troublesome. I was surprised to see them walking on foot on the hottest day".

21st July, "Having obtained the king's passport, ... we took leave of Bokhara in the evening"[3].

Burnes describes their tiresome delays on the journey to Meshed [275–6]. "We were...living as Asiatics, and had many a hearty dinner from the 'kabobs' of the bazar, but my faithful Hindostanee, once my head servant but now my cook and factotum, used...to...get things from the bazar which might betray us. We repeatedly prohibited these luxuries, but even in Bokhara we have had a breakfast on fish, eggs, coffee, preserves, and fruit, though it must not be believed that we always fared so sumptuously".

He describes their followers; "the most remarkable was Mohun Lal, the Hindoo lad from Delhi, who exhibited a buoyancy of spirit and interest...most rare in an Indian. At my request he kept a minute journal of events [which] if hereafter published...will arrest and deserve attention. ... The native surveyor, poor Mahommed Ali whose loss I have since had to deplore [401], generally travelled as a pilgrim proceeding to Mecca, holding little or no open communication with us[4]".

On 16th August Burnes received from Bukhara "a small packet, ... which consisted of three newspapers and a most kind letter from my friend M. Allard at Lahore[5]. The packet had been three months coming. ... We had not seen a newspaper since crossing the Indus in the middle of March".

Mohan Lal records that "after crossing the Amu R., 18th Aug., the pony of Mr. Burnes, ... a great favourite of his, was stolen in the night, and we were afraid to complain".

Once in Persia the party was amongst friends. They reached Meshed on 14th Sept. "The Prince Royal of Persia, Abbas Meerza, was now in the neighbourhood, ... and...we knew that there were British officers in his...service. ... We were agreeably surprised to receive a polite message from Mrs. Shee, the lady of Captain Shee[6]. ... We found ourselves more comfortable than since we had left India. ... We gladly changed the barbarous custom of eating with our hands and, though our fair hostess was a Georgian who only spoke Persian, we fancied ourselves once more among the society of our country. ...

"After a week's stay at Meshed, we quitted it on the 23rd of September, and marched...to Ameerabad, a distance of forty miles, and reached Koochan on the third day. ... As water boiled at 206°, we were about 4,000 feet above the sea. ... We reached the camp of Abbas Meerza a little before noon, and found ourselves once more in European society, ... officers in the Prince's service. ... In the evening we were introduced to the Prince Royal by Captain Shee".

At Koochan, 20–9–32, Burnes bade farewell to his companions, Gerard and Mohan Lal, and set out w. to the Caspian and Tehrān. From here he returned to Bombay, taking ship from Bushire [276][7].

In addition to his pub. account of this "ride to Bokhara" [276–7] was his official military memoir[8], which emphasized the physical difficulties of a route from Turkistān into Herāt or Afghānistān. He suggested that approach to India would more likely be made through Chitrāl or Kashmir [277].

During furl. to England, Aug. 1834 to May 1835[9]; he entrusted the compilation of his geogl. materials to John Arrowsmith [277; pl. 16].

At the end of 1836 Burnes was sent on a pol. mission to Kābul, under geogl. and commercial cover. He was given the asstce. of several capable officers—John Wood, Indian Navy, who made detailed surveys of the Indus and upper Oxus—Robert Leech, Bombay Engineers—and Percival Lord, Bo. Med. They left Bombay at end of 1836 and after detailed examination of the Indus, reached Kābul where Burnes made hdqrs. 20th Sept. 1837. He made close contacts with Dost Muhammad, and strongly advocated friendly relations with him, but could not conclude any agreement satisfactory to Govt. of India, which refused to ask Ranjīt Singh to restore Peshāwar to the Afghāns [244, 277–81].

"Finally", writes Holdich, "on April 26th, Burnes and Masson [456–7] left Kābul together in a hurry, and were subsequently joined by Lord and Wood, and thus closed a mission, one of the most extraordinary ever sent forth by a Government".

"Even if the wisdom of the despatch of his assistants (Leech to Kandahar, and Dr. Lord with Wood to Badakshan) may be questioned on political grounds, it led to a series of remarkable explorations, some of which even now [1910] furnish authority for Afghan map making[10]".

From Peshāwar Burnes submitted full reports of the work done[11], and then went to Simla to make personal report to the GG., Lord Auckland.

A policy opposed to Dost Muhammad was now adopted, and Burnes returned to Kābul under

[1] Mohan Lal (107).

[2] *Bokhara*, II (231–3).

[3] Mohan Lal (123).

[4] *Bokhara*, II (296–7).

[5] Jean François Allard (1785–1839); with Ranjīt Singh, 1822–39 *DIB.*; Grey & Garrett (80–92); Parks [II, 102].

[6] Benjamin Basil Shee (1803–40); Mad. Inf. 1820; comdg. dett. in Persia from 1837 as local Lt Col., KLS.

[7] *Bokhara*, III (66–100).

[8] *Description of Bokhara*, *JASB.*, II (224–39).

[9] *JRGS.* VII, 1837, paper sd. by Burnes, Karachi, Jan. 1836.

[10] Holdich (401–4).

[11] *Political, Geographical and Commercial Reports and Papers...1839*; with letter of, 26–5–38. *Bo. Geo. Trans.*, II (72).

Macnaghten to reinstate and support the unpopular Shah Shujah. He marched up with the Army of the Indus via Kandahār. From now till his tragic death his interests were political or "commercial" rather than geographical [281].

The following appreciation was written in 1926 ; "Burnes had no doubt that on all grounds—military, political, commercial—the time had come when Great Britain ought to cultivate alliances in Central Asia. ... Trained...to concentrate upon the exploration of the Indus and the defences of western India, Burnes...applied himself to studying Afghanistan and all the Moslem states between Afghanistan and the Caspian. ...

"He was the most adroit, most intelligent, and most practical minded of all the politicals. ... Physically insignificant and even puny, he commanded respect and admiration wherever he appeared in Asia. Genial, high-spirited, with a remarkable sympathy for the Asiatic character, and a genuine respect for the better side of Mohammedan ethics, he made friends with men of every class. ... He was ambitious, and... not inaccessible to compliments ; he was vain to the extent of overrating his personal influence and his own sagacity"[1].

Holdich regards him "as one of the greatest of English travellers. His name has its own high place in geographical annals. We shall never cease to admire the traveller, whatever we may think of the diplomat"[2] [450, 472].

Amongst his many reports are papers on Sind. From Kābul he sent to Bombay "a valuable native work on geography, the *Masalikwo-Moomalik*, with 21 maps[3]". To the ASB. he sent a collection of specimens and drawings of the "Zoology of the Indus", of which about 50 drawing were lithd. at cost of Rs. 5,682 ; "A portfolio of the finished and coloured lithographs, with the original drawings was...greatly admired, as being far superior to any thing of the kind hitherto produced in India". The ASB. could not, however, afford the expense of proceeding with the reproductions[4].

He submitted a large collection of coins from Afghānistān and Turkistān, some of which he presented to BM[5].

He was awarded the Royal Premium of the RGS. for his travels to Bukhāra. Bo. Geo. Soc. had his portrait painted and hung in their rooms ; *Trans.* VI. 1842 (18, 21).

CAMPBELL, JOHN. Mad. Inf.
b. 14–4–04. d. 18–4–75.

Ens. 14–5–24 ... Capt. 14–6–42 ; ret. 23–6–45.

Son of Duncan Campbell, merch., of London, late HEIC. Mar., and Harriet his 1st. wife, dau. of Robt. Mylne, FRS., archt., *DNB.*

m., Callingapatam, Chicacole, 6–1–36, Maria Henrietta, dau. of C. F. Davis, and niece of Capt. R. S. Dirkaz, master attdt. ; she d. 3–5–89, aged 72.

ed. Charterhouse ; originally intended for civ. engr.

Not to be confused with Sir John Campbell (1802–78), Mad. Inf. ; Ens. 1820 ; Gen. 1872 ; pol. duty in ch. suppression of Merriah human sacrifices, 1837–42 ; KCSI., 1866.

Appd. to svy. 26–1–36 ; assumed ch. of Salem svy. 8–4–36 ; proceeded 3–6–36 on mil. service to Goomsur joining Hill on svy. [pl. 15] ; resumed ch. Salem svy. under MGO. 5–3–37 [251–4, 302, 368, 377, 382].

From 1840, when fd. work was drawing to close, made every effort to prolong operations by taking up geol. and rev. svys., and revising earlier svys. of adjacent dists., but found no support from SG. or DSG. [121, 248 252–3].

"Nothing had been done towards completion of the Salem survey since September 1842, but that this officer and his establishment had been engaged on investigations regarding employment of natives on revenue surveys in the district of Tinnevelly, ... together with experiments to test the capabilities of the repeating instrument under his charge [250][6].

"Capt. Campbell also submitted...proposals relative to the revision of a part of Col. Lambton's work—constructing theodolites in this country at a reduced cost—and carrying on a revenue survey on a new system of his own"[7].

On this being brought to notice of GG in C., Campbell's services were replaced at disposal of Govt. of Ft. St. George for regtl. duty, GO., 22–3–44.

Amongst his many wild projects was one for floating a commercial company for working coal in Salem Dist. ; several of his reports were pub. *JASB.* ; X (159–4) ; XI (217–21 ; 293–7, 302) ; (894–6) ; XII, 1843 (368–9).

CARLESS, Thomas Grere. Indian Navy.
b. 1806–7. d. Bushire, 16–12–48, of smallpox[8].

Mdpn. 10–6–22 ... Capt. 28–8–48.

1837–8, survd. Karāchi and coast from E. mouth of Indus to Sonmiāni [246–7][9] ; *JRGS.* VIII, 1838 (328 *et seq.*).

Bo. Geo. Soc., I (142–72). Memoir on Gulf of Akabah, at head of Red Sea.

CONOLLY, Arthur. Ben. Cav.
b. 2–7–07. d. c. 17–6–42, murdered at Bukhāra.

Corn. 30–7–23 ... Bt. Capt. 30–7–38.

Son of Valentine Conolly, late Surg. Mad. Med., and Matilda his wife ; bro. to Edward [*inf*] ; 1st cousin to Sir Wm. Macnaghten (1793–1841), *DNB.* [281].

ed. Rugby, 1820–2 ; Addiscombe, 1822–3.

DNB. ; *DIB.* ; *Oriental Club* ; Davis (19–20, 30) ; Hodson, I (372–3).

10–8–29, left London on return from furl. overland through Russia, Persia, Herāt, and Kandahār ; pub. account, 1834, *Journey to the North of India overland from England* ; 2 vols. [276, 283, 290, 293].

Ben. Regr., 288 (167), sketch of country between Tiflis and Delhi, 36 m. to inch, 1830–1.

1834–8, pol. duty, Rājputāna ; joined Macnaghten's staff at Kābul, 1840, and deputed to Turkistān [447].

CONOLLY, Edward Barry. Ben. Cav.
b. 2–3–09. kd. in action, 29–9–40, at Fort Tutamdara, N. of Kābul.

Lieut. 25–5–25 ; Bt. Capt. 25–5–40.

bro. to Arthur [*sup*] ; both in 6th Cav.

ed. Brasenose Coll. Oxon., matric., 15–3–32.

DNB. ; *DIB.* ; Hodson, I (373).

1838–40, Afghān War, comdg. escort with Shāh Shujah.

JASB., VI, 1837 (813–56), "Observations [descriptive] on Oujjain".

1839, journey from Persia to India, via Herāt, 11–8–39, Sistān, Kala Bist on Helmand R. ; *JASB.* IX, 1840 (710–26), "Sketch of the Physical Geography of Seistan", with map showing route from Herāt to Helmund R. ; "Any merit which the map may... possess should be attributed to Sergeant Cameron, who surveyed the whole route, except...between Seistan and Killah Boest [284]. ...

"The survey has been made only with the compass, but a flat country...is so easily laid down, we had so many well determined points d'appui, that I feel confident of there being no error. ... The villages in the valley of Furrah are placed from native information. During our stay in that valley there was a thick haze which prevented the taking of a bearing.

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[1] Davis (23–4). [2] Holdich (461). [3] *Bo. Geo. Soc.*, I (9, 22–31, 92–372). [4] *JASB.* XII, 1843 (616) ; XIII, 1844 (c–ci) ; XVI, 1847 (853). [5] *Bokhara*, III (369–74) ; *JASB.* II, 1832 (VII, 305–18). [6] DDn. 451 (147–9) ; BMC., 12–4–44. [7] DDn. 452 (329) report for 1844–5. [8] *JRGS.* XIX, 1849 (xli). [9] *JASB.* VIII (184–202) Markham (22).

"The untimely end of Sergt. Cameron has been already made public. This man, the son of a respectable builder of Perth, after his return from Seistan, accompanied me in a journey through...the Eusafzye country[1]. I cannot speak too highly of his zeal for science, industry, ready talents, and gentlemanly deportment.

"His health failed him in Seistan, from whence to the Helmund we were obliged to have him carried on a bed. Afterwards he rallied again, but his disease, consumption, was latterly gaining upon him, and I do not think that under any circumstances, he could have lived many months longer.

"On returning from Peshawar towards Kabul", writes Conolly, as Cameron "was too weak to travel, except slowly, I left him at Peshawar to follow at his leisure, and myself went on in advance with a few horsemen to Jelalabad. He had a strong guard with him, and had nearly reached the end of the Khyber Pass. Unsuspicious of danger, he had dropped in rear of his party, when on a sudden he found himself surrounded by sixty men, while sixty others appeared on the hill above him. Seeing that resistance was hopeless, he dismounted, and drawing his sword, presented it to the nearest of the robbers. Just at that moment a stone struck him on the head and knocked him down; the ruffians in their blind fury rushed on him and cut him to pieces with their knives"[2].

Work of Conolly and Cameron embodied in MRIO. 111 (4-7).

COOPER, George Lewis. Ben. Art.

b. 2-2-12. kd. in action, 25-9-57, at relief of Lucknow.

2/Lt. 2-2-28 ... Bt. Maj. 20-6-54.

Son of M Gen. George Cooper (1780-1847), Ben. Inf., and Jane his 1st wife.

m. 1st, Meerut, 9-11-34, Catherine Mary, dau. of Robt. Chamberlain, BCS. [II, 402].

m., 2nd, Lucknow, 8-10-46, Mary Ann Griffin.

ed. Addiscombe, 1826-7. Hodson, I (381).

Geo. Mag., I, 1874 (3); Afghān war, 1839-40, svy. of Bugrān R., tributary of Helmund [284].

COURT, Claude Auguste. French Military Officer with Ranjit Singh.

b. Grasse, 1793. d. Grasse, 1861.

Arrd. Lahore Feb. 1827. Left Lahore, Sept. 1843.

DIB.; Grey & Garrett (148-60). FRGS.

1813, passed out from Mil. Polytechnique, Paris; resd. comn. 1818. Migrated to Persia, taking service with one of several rival princes.

1826, travelled to Lahore with the Italian Avitabile. Starting from Yezd they travelled through Herāt and Kandahār. At Ghazni they were seized, stripped, and searched; "I trembled for the safety of the numerous notes I had taken during the journey, but luckily these had been sewn in the bosom of my eastern dress, and escaped detection". Reaching Kābul 13-11-26 they stayed there several weeks. After being imprisoned at Peshāwar they were permitted to proceed to Lahore, where Court was given comd. of Ranjit Singh's artillery.

From notes made on this journey Court compiled an "Itinerary" and map, about the latter of which the Directors expressed anxiety[3]. Burnes was so much impressed with the value of Court's work that at his suggestion Court offered it to the Govt. of India, who purchased it in 1833 for Rs. 5,000. The "Itinerary" lay unused in Govt. archives at Ludhiāna until transl. and pub. in Grey & Garrett's *European Adventurers*, 1941[4] [274, 276, 444-5].

Court was well educated, and contributed several papers to ASB., including a "Memoir on a Map of Peshawar and the country between the Indus and the Hydaspes", with a description of the ruins of Taxila, and conjectures on the march of Alexander [I: 232][5].

An account of his mil. services with the Sikhs from 1827 to 1843 is given by Grey & Garrett, together with notes on the other officers, Allard, Ventura, and Avitabile.

When he returned to France Court took with him his second Kashmiri wife, who had become a Christian, and they were married at Marseilles in June 1844.

The life of an adventurer of those days was a hard one, and Court's advice to Burnes when he started out on his journey to Bukhāra was; "Si tu veux vivre en paix en voyageant, fais en sorte de hurler comme les loups avec qui tu te trouve"[6].

CREED, Henry. Bo. Art.

b. 27-3-12. d. 3-10-77.

2/Lt. 12-6-28 ... Capt. (12-6-43) 1-9-48; ret. 4-10-49.

Son of Richard and Jesse Hannah Creed; twin bro. to Richard, also Bo. Art.

m., 1st, Southsea, 3-9-45, Frances Gwynne, dau. of M Gen. Sir David Ximenes, KCH. She d., 11-4-47.

m., 2nd, Knowle Hill, 25-10-50, Cécile Aurélie, dau. of Harold Augustus, 7th Marq. de Bourbel, of French diplomatic service.

1839-40: Afghān War; svy. of route from Ghilzai to Pishīn [283].

IO. Cat. (453), "route map from Rohree to Khyerpoor and the frontier of Jessulmere"; Bombay, 22-5-40.

Held comn. comdg. Middx. Art. Volunteers, 1861-71.

CUNNINGHAM, Alexander. Ben. Engrs.

b. 23-1-14. d. 28-11-93.

2/Lt. 9-6-31 ... Col. 16-6-60; Scottish ret. as Hon. M Gen., 30-6-62.

Son of Allan Cunningham, Scottish auth. (*DNB.*) and Jean Walker his wife; bro. to Joseph [429].

ed. Christ's Hosp.; Addiscombe, 1829-31; Chatham, 1831-2.

m., Simla, 30-3-40, Alicia Mary, dau. of Martin Thos. Whish, BCS.

ADC. to GG. 1836; CSI. 1871; CIE. 1878; KCIE. 1887.

DNB.; *DIB.*; Conolly (88/178). Hodson, I (430-1); Condon.

MRIO. 31 (82), Map of country between Moghal Sarai and Mirzāpur, Oct. 1835 [268].

June 1839, left Simla with Broome to Kulu; branched w. by himself through Kangra to Pathānkot and Jammu, to reach Srinagar in Sept.; map to SG., and report sd. Lucknow, 8-2-41 [260, 292, 360].

1846-7, joint boundary commr. Tibet frontier making sketches from Ladāk to Spiti: *JASB.* XVII, 1848 (13-60, 89, 93-105, 201-30).

Prolific writer; *Journal of a trip through Kulu and Lahoul to...Ladak*, pub. Simla 1847. *Ladak, Physical, Statistical, and Historical*, London, 1854. *Bhilsa Topes, or Bhuddist Monuments of Central India*, London, 1854; besides many papers for ASB.

Keen archæologist and numismatist, and his *Ancient Geography of India*, London, 1871, is an authoritative work.

1840-61, in PWD.; 1861-5, Archæological Surveyor to Govt. of India; 1870-85, Dir. of Archæol. Švy.

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[1] N. of Peshāwar. [2] *JASB.* IX 1840 (725 n.). [3] copied in QMG.'s office; scale 2·8 m. to inch; MRIO. 111 (3). [4] Grey & Garrett appx. III (xxvii-xlviii). [5] *JASB.* V., 1835 (387-95; 468-82). [6] Holdich (457).

CUNNINGHAM, Joseph Davey. Ben. Engrs.
b. 9-6-12. d. nr. Ambāla, 28-2-51.

2/Lt. 10-12-30 ... Capt. 13-11-49.

bro. to Alexander [428].

ed. Addiscombe, 1829-30 ; Chatham, 1831-32.

DNB. ; *DIB.* ; Conolly (88/176) ; *Punjab Inscpns.* Hodson, I (451).

Auth. of *History of the Sikhs*, 1849 ; *JASB.* xiii, 1844 (172-253) ; "Notes on *Moorcroft's travels in Ladakh* and on "Gerard's *Account of Kunawar*" [iii, 451, 486] ; xvi, 1848 (305-12), on Ruins at Butharee.

1833-5, survd. line of proposed canal Rājmahāl to Hooghly R. [267].

1837-45, on pol. duty Ludhiāna ; 1846, Bhopāl.

DAVIDSON, David. Bo. Inf.
b. 18-8-11. d. 18-5-1900.

Ens. 4-12-27 ... Capt. 5-7-44 ; furl. 1847-50 ;
ret. 20-2-51 ; Hon. Maj. 28-11-54.

Son of Henry Davidson, writer, Haddington, and Martha Mary Chisholm, his wife ; bro. to A. Fletcher Davidson, b. Haddington, 1822-3, asst. Supt. Rev. Svy., Ahmadnagar, 1851, uncov.

m., 1849.

cb. 1881 ; kcb., 1897, for Volunteer services in Scotland ; Col., Queen's Edinburgh Rifle Vol. Bde. 1860-83 ; vd.

Auth. of *Memories of a long Life*, Edin. 1890, with portrait ; Boase ; *Who Was Who., 1897-1915*.

bo co. 5-12-37, appd. Asst. Rev. Survr. Deccan, being confirmed as Rev. Survr. from same date under bo. rc. 14-5-38 [236, 366].

Not to be confused with David Davidson (1804-71), also Bo. Inf. and Rev. Svy., 1824-9 [iii, 436].

Has left many interesting notes on the rev. svys. ; especially of Goldsmid and Wingate [qv]. "The names of Goolmit and Engate Sahibs were introduced into the doggerel lay which the Maratha housewife chants while at her daily task of grinding corn. ...

"The newly appointed officers joined Lieut. Wingate at his camp in the village of Opplaoe Boodrook in the Sholapore District and, as it was at first intended to correct the errors of the first survey [Pringle's, 235-6] and adopt it so revised, ... our first employment was in checking the measurements. It was found, however, to be so inaccurate, that soon after an entirely new survey and classification of the soil was resolved upon. ...

"When we dispersed at the beginning of the monsoon, all except myself went to Poona, while I preferred remaining with Mr. Wingate at his headquarters, ... where there was a Government bungalow. ... The Bheema, on a high bank on which the bungalow stood, when flooded is broad and rapid. ...

"During my second season in the Sholapore District, I was employed in correcting the survey of the talooka of Mohal, for which I was...to propose new rates of assessment".

Amongst many new devices which Davidson claims to have introduced was the illustrating of his reports by means of diagrams, "the first use...of the diagram to illustrate statistical results whether at home or in India".

On the outbreak of the Afghān war nearly all of the mil. officers were withdrawn ; "At the end of 1839 I was one of the only two left of the original selection. At the close of that year, Mr. Goldsmid instituted the revenue survey of the Ahmednuggur Collectorate, beginning with...Nassik, and I was appointed his assistant and successor" [367, 397].

Davidson "proposed a new plan for describing the boundaries of fields, as the existing one involved a great deal of writing. ... Hitherto we had no village maps, so I proposed to furnish the measurers with scales and compasses, to enable them to protract each field as they measured it, and by joining them together, to form a map of the village. ... The village maps were so correct that we joined them together and formed a map of the talooka [237-8]. ...

"I was shortly appointed Superintendent of the Ahmednuggur...Assessment. As the permanence of the survey would depend on the preservation of the boundary marks of fields, and stones only had been used, ... something more permanent was necessary. Mr. Goldsmid made the experiment of throwing up ridges round the fields, but the expense was...enormous. ... I proposed...that the ridges should be thrown up at the corners and bends only" [238].

He spent the rains at Nasik. "Mr. Tytler of the Civil Service[1], who had the survey of the hill villages, met simultaneously with myself an accident in riding. He broke his collar-bone, and I injured my leg. ... We lived together in Nassik". ...

"My regiment having been ordered to Sinde in 1843, ... I thought it my duty to ask to be relieved for the time of my civil work. ... I was informed that the Commander-in-Chief did not wish any more Captains with the 18th, and that I was to remain at my post. ... The 18th saw no service in Scinde. ...

"The survey and assessment of the Nassik sub-collectorate being finished, I shifted my headquarters to Ahmednuggur". He now applied for furl.—"nearly 20 years of service with scarcely any leave—had never visited any cool sanatorium. I was asked to suggest my successor, and it was arranged that a brother-in-law of Sir James Outram was to take my place".

Handed over ch. to George Anderson [300][2], and sailed from Bombay on 1-4-48. Stayed at Shepherd's Hotel at Cairo. Whilst in London gave evidence "before the Court of Common Pleas at Westminster in a case...versus Elwood, the latter claiming to be the sole inventor of...a ventilating hat. My hat had been the invention of Maj. Gaisford of the Artillery [443], who had it made for me of date leaves. At the trial, it was wonderful the variety displayed of the application of the principle of a hat within a hat, and the air circulating between".

On return to India declined offer to succ. Wingate, preferring to take pension on attaining 20 y. service. Visited Ahmednagar. "Having joined the camp of my brother Fletcher, who was one of the Assistant Superintendents, I went out with him on his morning's work...as a looker-on"; his last weeks of survey life.

"The hill tent, with felt over its inner fly and walls to intercept the scorching sun ; the glass windows, and wet kuskus mats to cool the hot wind ; the portable copper bath to refresh the body after a hard morning's work, and all the contrivances for rapid...shifting of the camp.

"Every article with its own receptacle ; quilted cotton bags for glass and crockery, into which when thrust and the string drawn they were snug and safe. Spring cart, with tilt and boot to hook on behind, into which to stretch the legs when travelling at night, when, with my bullocks, Raja and Motee, and Seeta Ram to drive, I could get over 30 miles before dawn, and ride...3 horses fifty more to breakfast.

"Sometimes, but rarely, I had to adopt the slower but more luxurious mode of travelling by a palanquin.

"I found that 3 years luxurious living at home had somewhat spoiled me for the frugal fare to which I had been so long accustomed in my tent life. ... The fowls and mutton seemed unusually tough, and chupattees, or thin unleavened cakes, a miserable substitute for bread"[3].

Davidson had always been a keen sportsman, and he invented a telescopic sight for target and game shooting.

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[1] Chas Fraser-Tytler (1816-81) ; bocs. 1836-62 ; Mgte. & Collr. Ahmadnagar ; bro. to Wm. F.-T., survr. [472].

[2] of Anderson's of Mounie, and pr. bro. to James Outram's wife [460].

[3] Davidson (186-96, 218, 227, 239-45, 276-9, 292).

DE L'HOSTE, Edward Paterson [III, 437]. Bo. Inf.
bapt. 13-8-03. d. 19-7-76.

Ens. 21-2-24 ... ret. as Hon. Lt Col. 1-10-52.

Son of Brig. Solomon De L'Hoste and Sophia Caroline Destrac, his wife.

1829, survd. Narbada R. [III, 123].

1831-2, survr. with Henry Pottinger's mission to Sind [244, 266]. Route books, MRIO. M 217, 218, give his own routes and others "collected from native information"—a Map of Sind, from Sukkur to Sea, MRIO. 120 (1). His journal, preserved in BM. Addl. MS. 14382, was pub. *Bo. Geo. Soc.*, II (22 *et seq.*).

Bo. Geo. Soc., I (9, 145-68), journal of march from Ahmedābād to Sukkur [245-6].

DE PENNING, Joshua [II, 394-5 ; III, 437-9]
Chief Computer.
b. Chingleput, 9-8-1784. d. Calcutta 30-3-45.

Appce. Survr. 1798 ; Sub-Asst. 1805 ; resd. 1824 ; re-emp. SGO. Madras, 1823-31 ; appd. Ch. Compr. Calcutta, Nov. 1831 ; ret. Nov. 1843 [17, 379].

Son of Peter De Penning, sgt. of Mad. Art., and Marie Sicé his wife, who were living at Pondicherry in 1831.

m., Pondicherry, 18-6-10, Marie Elizabeth Hypollitte Gille, by whom he had 14 children. The descendants of his son Geo. Alfred, b. 1830, now conduct business of Patent Agents in Calcutta[1]. His eldest dau., Caroline, who took after "the placid manner of her mother" [III, 472], m., Calcutta, 23-12-46, John Graham, hd. dmn., SGO. [445].

Selected by Everest for ch. of the new comp. office at Calcutta, and granted salary of Rs. 400 in addition to Madras pension of about Rs. 80 [3, 338, *inf.*]. Writes from Madras, 2-9-31 ;

"I am preparing for embarkation...by disposing of my furniture and landed property, and...I intend to make a run post to Pondicherry to see my parents, and make some provision for them, and hope to return in a week or ten days at the most. ... Not knowing if either Mr. Olliver or Mr. Rossenrode be at Calcutta, I am at a loss whom to apply to for securing me a small house or bungalo, or any place near your office for the accommodation of my family on my arrival at Calcutta, to which place I shall be a perfect stranger, and I have a great aversion to an hotel"[2].

Six weeks later, passages being as difficult to arrange as in 1948, he "met with a severe disappointment in endeavouring to procure a passage...on the Lord W. Bentinck. ... I kept myself and family in perfect readiness to embark the moment I should obtain warning from the Marine Board. Day after day passed without notice, till the evening that the vessel was to sail, when I waited on the Secretary to the Marine Board...with a letter from Captain Montgomerie. ... After waiting...for an hour, I was dismissed with the information that the Secretary and the Agent could not come to terms about the sum required for my passage.

"Dispirited and disheartened, I returned to my family who, with Mr. Olliver's four sons [III, 491 ; IV, 375] our servants, all equipped and ready for embarking, were waiting for the signal to proceed"[3].

They got away, however, the following week, and De Penning writes from the Hooghly, 9th Nov., reporting "arrival of Kedgeree this day, on board the ship Waterloo, ... after a passage of 20 days from Madras, which port we left on the 21st ultimo [I : 303]. The pilot calculates on reaching Calcutta about 18th or 19th instant. I am glad to say we are all well on board[4]".

The comp. office started in 35 Park St., next door to SGO. [331-2], and De Penning apparently had quarters in the same house. He asked that office hours should be "from 10 in the morning till 4 in the evening, allowing an hour or more for dinner between the hours of 12 and 2, that is, when dinner is announced". He insisted that he had accepted the appt. with stipulation that he should not serve beyond Calcutta [15, 49, 338].

On Everest's move up-country at the end of 1832, De Penning was left in general ch. of corr. and drawing offices, and authorized to take action on Govt. orders for which there was no time to refer to SG. On the comp. side he was invaluable, as the SG. acknowledged more than once [94, 101-3, 108-12, 314, 337-42, 344, 371], though there were occasions when Everest's unrestrained impatience threw undeserved blame on the patient De Penning, as when there had been unavoidable delay in despatching the great theodolite by river steamer [142]. On several occasions, moreover, De Penning was sharply reprimanded for acting on his own responsibility instead of making tedious ref. to the SG. [434-5].

De Penning was responsible for the comp. and drawing office staff, but protested at the additional burden thrown on him by Barrow's move up-country [127-8, 132-3, 140, 146, 285, 296-8, 332-3, 418]. He organized transmission of daily time signals to Ft. Wm., entrusting the details to Rees [114-5, 462].

The arrival of Bedford as DSG. in ch. of rev. svys. led to some friction, that was partly removed when Bedford took over as SG.'s deputy, leaving De Penning free in the comp. office [324-6, 345, 420, 437].

After ten years at Calcutta he hazarded an appeal for rise of salary ; "During the many years which it has been my duty, as well as my best gratification, to correspond almost daily with you, ... I have never yet had occasion to address you on my private affairs, my embarrassments...or my hopes. ... I know that from you...my complaints...would meet with the most patient attention. ...

"I need not refer to my former services as Chief Assistant to Colonel Lambton, from the commencement of his career until his death in 1823, ... but rather found my claims...on the labour...and perseverance of my later services. ... In asking for an increase to my present salary...I...respectfully request...your powerful influence...to enlarge my present salary, which amounts to only Company's rupees 496-12-0 —Company's rupees 418, my pay as Chief Computer, and... 78-12-0, the...pension...for former service —...by permitting me...henceforth the sum of Company' rupees 600. ...

"For...six years a duty altogether distinct...to my own was performed by me. ... the charge of the Surveyor General's Office at Calcutta. That...Major Bedford should have been selected for my successor is a sufficient voucher. ... Its duties have been diminished by the removal of the vast department of Instruments formerly attached to it. ... For these costly and delicate articles I was for years accountable. ... I was directed...to give mean time to the shipping in the river. ... The arrangements still in use are entirely my own ; the most difficult portion of the task was mine. ...

"I have hitherto received no remuneration...[for] charge of the Mathematical Instrument Maker's establishment. ... Mr. E. Gray was appointed to relieve me on an allowance of 350 rupees per mensem [124]. It has since been transferred to Captain A. H. E. Boileau [124, 422]. Will it be deemed that I am unreasonable in claiming for the fifteen months ...the same salary as was received by the former ? Day and night I toiled, with the wants of a wife and eleven children to stimulate my exertions. ... Though, thank Heaven, I am still healthy, I am nevertheless an old man [aged 57]. ... I am labouring under a load of pecuniary difficulty. ... The children will be wholly unprovided for[5]".

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[1] *Statesman : Patents Centenary Suppt.* 5-3-1956. [2] DDn. 264 (238-9). [3] ib. (256-7), 13-10-31. [4] ib. (269). [5] DDn. 307 (276-82), 11-8-41.

His appeal was warmly supported by Everest; "I first became acquainted with Mr. De Penning when I joined the G.T. Survey at Hyderabad...under the late Lt.-Col. Lambton, ... who habitually spoke of him as a father might speak of a son to whom he was affectionately attached. He joined my honoured predecessor when very young. Had been trained up under his own eye, and had so won his confidence by his...intelligence, that he had become quite indispensable [III, 430]. ...

"I ventured to point out to Government in 1831 his peculiar fitness to be placed at the head of my Computing Office [338]. He was at the time employed under the Deputy Surveyor General at Madras, ... bearing still the same high character for efficiency. ... I could not have brought a more deserving servant to the notice of Government, or better promoted the interests of my masters. ...

When...I quitted Calcutta...a great addition was made to his...responsibility, and none to his salary, which continued until 27th December, when he was relieved from the charge 11th August 1837, ... When Mr. Barrow left Calcutta on the by Major Bedford. ... Mr. De Penning was ordered to take charge of his establishment. ... This really formed no more a part of the duty of Chief Computer than of any other individual. ... He received no addition to his salary, ... and held the charge gratis until the 5th November 1838. ... Mr. De Penning is right in designating this a most trying duty [123–4, 136–7]. ...

"The applicant is now an old man, ... encumbered with a large family—7 unmarried daughters and 4 sons, all unprovided for, and looking up to him for their maintenance.

Govt. sanctioned an increase of Rs. 100 a month, as a personal allce., not to be ante-dated[1]. On Bedford's resn. De Penning resumed ch. of SGO. from 31–12–42, and held it till Everest's return to Calcutta on 20th Nov. 1843. After sailing for Europe Everest wrote him a sympathetic, appreciative letter of farewell; "You have had a most arduous duty to perform, and...you have discharged it well. ... I have often deeply sympathised with you, and wish I could have bettered your circumstances"[2].

This contrasts strangely with the petulant rebuke, so typical of Everest, that poor De Penning received a few months before, having unwisely signed the title-page and chart of one of the reports on which he had worked for years.

"I observe that all the plans are signed 'Joshua De Penning, in charge of Surveyor General's Office', which is erroneous, because I am in charge, ... and your specific designation is 'Mr. Joshua De Penning, Chief Computer, in temporary charge of the Surveyor General's Office at the Presidency'. ...

"Although during the lifetime of Lt.-Colonel Lambton, you actually were entrusted...with...much more individual responsibility...than in this instance, yet when, I pray you, did you ever venture to sign your name to the G.T. Survey plans, or to thrust your name prominently forward in the title-page? ...

"No deviation from the form and style of the volumes of the General Report and Maps adopted by Lieut.-Colonel Lambton shall take place, except such as are expressly ordered by myself. ...

"I have ordered the books to be unbound, and rebound, that the title pages may be replaced, and the 8th Volume be uniform in appearance with the others; also that your signature be erased from all the plans, in order to leave room for that of the Superintendent G.T. Survey of India"[3] [111–2].

From the time of the SG.'s return to Calcutta, De Penning had no duties outside the comp. office, holding ch. till his death, when the DSG. reported, 31–3–45, "the sudden demise of Mr. J. De Penning, who expired yesterday after 9 hours illness"[4].

His widow was left with a heavy burden, and writes, 25–4–46; "The late Mr. De Penning has left a large family consisting of six grown-up daughters and three sons[5], one of the former and two of the latter being still at school. The eldest son only was able to earn a livelihood, but...lately lost his situation by the abolition of the mercantile house of W. W. Robinson & Co., in which he was employed, so that our present only means of support is a pension of one hundred rupees per month...from the Uncovenanted Service Family Pension Fund, to which my late husband had been...enabled to subscribe by maintaining the strictest economy in his domestic establishment.

"This pension, which must terminate with my life, is... inadequate for the support of six daughters and three sons, and for the education of the three youngest. ... We occupy a house at present nominally our own, for which we pay no rent, and which my late husband purchased. But the expense of enlarging the same involved him in a heavy debt, amounting to about seven thousand...rupees, ... leaving me no other alternative but to dispose of the house for the satisfaction of my creditors".

She asked for compassionate pensions for her daughters[6].

Waugh replied that he had thought De Penning had left his family well provided for, but regretted that there was little hope of "obtaining any pensionary provision whatever for yourself or amiable daughters". He pointed out that Govt.'s power to grant family pensions was "strictly limited to the families of those who are killed on service, or in the execution of their duty". He could only suggest that Mrs. De Penning should address a petition to the Court of Directors, sending one copy through himself, and another to Everest. He concluded with pious wishes for the eldest son's success in finding employment[7].

DURAND, Henry Marion. Ben. Engrs.
b., Coulandon, France, 6–11–12.
d. Tonk, nr. D.I. Khan, 1–1–71, MI.

2/Lt. 12–6–28 ... M Gen. 1–3–67.

Son of Col. the Hon. Henry Percy, CB., 14th Lt. Dragoons, and Jeanne Durand.

m., 1st., Meerut, 28–3–43. Anne, dau. of M Gen. Sir John McCaskill, KCB.; she d., Mhow, 28–8–57, aged 35.

m., 2nd, 1859, Emily Augusta, dau. of C. A. Allnut, of Shrewsbury, widow of Rev. Henry Stedman, Ben. Eccl.

ed. Addiscombe, 1827–8. CB. 1858; KCSI. 1867.

DNB.; *DIB.*; Hodson, II (107–8); bio. *M Gen. H. M. Durand*, by his son, Henry Mortimer[8] pub. 1883; Conolly (88/159); *Punjab Inscpns.* (96–7).

Attracted Everest's attention in March 1828 as a young officer under instrn. [351–2]. Sailed for India Oct. 1829; shipwrecked at Cape; arrd. Calcutta, 20–5–30. Not available for GTS., 1830 [318 n.4].

1834, Asst. Supt. Ferozeshah canal [65], submitting svys. and reports on drainage of swamps nr. Delhi, 1838.

Several times PS. to GG.

July 1838, Everest applied to GG. for his appt. as Asst. in SG.'s fd. office[9]. "The Surveyor General, ... finding himself overworked, had applied for a deputy to assist him, ... and Lord Auckland at once named my father as the best man for the duty. Colonel Everest agreed, and...a friend... wrote; 'Rely upon it, Durand, here is an opening. The idea of your value is universal in the Lord's camp, and Everest would be delighted'. ... Before he could join the Survey...another and more promising opportunity presented itself—...Secretary to the Sudder Board of Revenue, Bengal [320].

"At the end of September 1838 my father heard that he was to be attached to the advancing force (Army of Indus) as one of the Engineers charged, in addition to their ordinary duties, with the work of the Topographical Department—surveys of fortresses and the like"[10].

With Anderson, appd. to the Army of the Indus which marched from Ferozepore, 10–11–38; svy. of route through Sind and Bolān Pass — Quetta —

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[1] DDn. 402 (189–92), 9–12–41; Mil. Dept., 5–1–42.

[2] Madras Roads, 19–12–43.

[3] DDn. 475 (14–7), 5–8–43.

[4] DDn. 471 (137).

[5] Wm. had d., 17–3–44, aged 19.

[6] DDn. 463 (113–9), 28–4–46.

[7] DDn. 464 (60½), 3–6–46.

[8] of Durand line, Indo-Afghān border, 1888.

[9] SG. to Mil. Dept., DDn. 342 (213–5).

[10] Durand (37).

Kandahār — Ghazni [246, 282, 360]; at blowing up of Kābul Gate, Ghazni (Sandes, I. 272). Sketch of Ali Masjid, MRIO. Misc., 7-O-39 [417, 446-7, 468].

PS. to GG., 1841; Comnr. in Tenasserim, 1844-6; furl., 1847-8; Sikh War, 1849; various pol. appts. included AGG. Indore, 1857-9; Foreign Sec., 1861-5; Viceroy's Council, 1865-70; LG. Punjab, 1870-1.

Died of injuries received at Tonk by elephant howdah being crushed under gateway arch; MI. recorded on gate.

DU VERNET, James Smith [III, 440-1]. Mad. Inf.
b. 26-4-03. d. 2-11-72.

Ens. 2-5-23 ... Capt. 31-10-43 ... Bt. Lt. Col. 4-11-56; ret. 21-4-57; Hon. Col. 29-5-57.

Son of Lt Col. Abram Du Vernet, RA. & Miriam his wife.

m., Truro, 20-8-38, Eliza Lavinia, dau. of Benj. Martindale, of Brunswick Sq., London.

1828, appd. Asst. Survr., Malabar [III, 114]; 1830, with party to Madura; 6 mo. leave to Nīlgiri Hills on mc. from 1st July; 3-12-32, to ch. Hyderābād svy.; "I was chosen on my arrival in India for the Survey Department. ... I served with Major Ward as his first assistant in the provinces of Malabar, Trichinopoly, and part of Tenevelly [250, 361]. When in charge of the Hyderabad Survey I surveyed the circars of Naldroog, Kulburga, Mallangoot, Eilgundil, and...the western boundary of the Nizam's dominions between Sholapur and Jaulun. ... Over these tracts...I extended a series of secondary triangles, and calculated their latitude and longitude etc., ... and I have myself taken up the detail of about two thousand square miles [256, 368].

"I performed the triangulation and directed detail of the field work—requiring great exertion and constant exposure, being unassisted, ... so that I was for seven months in the year, from day-light till night, exposed to the rays of the sun, either on horseback on the march, or on hills observing.

"On returning from the field my time was entirely occupied in bringing up the account of my work, and...I had not transmitted the plans and papers...before the season had arrived to resume field operations"[1].

Resd. 13-2-36, and whilst on furl., May 1836 to July 1839, applied to SG. for appt. to GTS., explaining that "dislike to India induced me to throw up my appointment at Hyderabad and return to Europe, in the hope of being able to resign the Company's service, but, disappointed in my expectation, I find I must return to India at the expiration of my furlough in April 1839, and, having been employed in the Survey Department for the last eight years, and for three years under your immediate orders, ... I now request...that I may be re-employed...in charge of a Survey. ... Please address to J. Du Vernet, Esq., Stoke Villa, Devonport"[2].

Everest wanted recruits for the GTS., and though the batt. already had six officers absent, Madras Govt. agreed to the appt.; "Capt. Du Vernet" writes Everest, "though unquestionably a very able officer in the topographical operations...under the Madras Presidency, yet has never been employed in the operations of the G.T. Survey, which latter require a nicety not needed...in the former. ... Until practical proof be afforded, I cannot consider myself warranted in recommending his advancement to... 1st assistant"[3] [357, 367].

Official notice of his appt., as 2nd Asst. on Rs. 250 p.m., 18-3-40, found Du Vernet "employed on the survey of a new road from Madras to Bombay", and he did not reach Dehra Dūn until 29-9-40. He spent the next four months at Meerut, laid up "by jungle fever caught at Dehra. Since my return from furlough in 1839 I have been six months with the 24th Regiment N.I., when I was transferred to the 2nd European Regiment as fourth Lieutenant, being the most unfortunate officer of my rank in the Army.

"In January 1840, my services were placed at the disposal of Government for...the G.T. Survey of India, but I did not receive orders until May, when, owing to the lateness of the season, and...inclemency of the weather, with the accidents that befel me en-route, viz., the sinking of one boat, ... by which I lost almost all my property, and narrowly escaped with my life, being a long time in the water, I did not succeed in joining the head quarters of the G.T. Survey until the latter end of September, when it was proceeding to Sironj[4]. At Kaliana I was taken sick, ... and did not recover my health sufficiently to enable me to take the field until February".

He begged that this explanation of his delay in taking up his appt. should be accepted, for if he was now sent back to his regt., "I should be utterly ruined, my losses on the river together with travelling expenses amounting to Rs. 5,000, and I would not get back to my regiment under two thousand more. Government did not allow me my salary until I arrived at headquarters"[5].

Everest accepted his explanations, and told Govt. that the 'illness which prevented him from joining me from October to February...was one of those...calamities from which the most robust constitutions are not exempt, ... His boat on the Ganges was on two occasions wrecked, and himself and family drenched for hours in the water. ... He had afterwards so long a distance to travel by land in the months of August and September, the two most unhealthy of the year, it is...not matter for surprise that the Captain had a severe attack of fever, but that he should so easily have got over it[6].

Season 1841-2, deputed to start the longl. series connecting the northern ends of the Gt. Arc and Budhon Merdl. series through Garhwāl and Kumaun [64, 320, 377-8, 382]. Everest was far from satisfied with the first season's progress, nor did he appreciate Du Vernet's excuses for poor outturn. He was, moreover, offended by Du Vernet's objection to the inconvenience "of attending office...at Hatipaun. ... I have...taken a house at Dehra, and have now two on my hands. Should you...take me from my present work and order my attendance at Hatipaun, I shall be obliged to hire another, and pay 800 rupees for the use of it for two months. Houses in the hills being let by the season only. ...

"It would be agreeable...could I conveniently live at Hatipaun, but in the case of sickness it is beyond the beat of the Surgeon at Mussoorie [440], and the medical officer in charge of the Survey at Dehra could not, except on some very urgent occasion, leave his patients there.

"Last year I paid 800 Rs. for my house at Hatipaun for the space of 5 months, but my salary is wholly insufficient to meet such expenses, and, from experience, it is too far out of the way to reside there. As for marching a distance of 8 miles daily to attend an office during this heavy monsoon weather, it does not appear to me reasonable. ... Hatipaun, however, agreeable as a residence to you, is most inconvenient to myself, and doubtless generally to those connected with the department.

"As I can perform any calculations you may desire...no less satisfactorily at Dehra as on the hills, I hope you will not press my attendance at Hatipaun"[7] [166].

Everest replied that as Du Vernet's own comps. could not be heavy owing to his small output of trign. he might well have assisted in the general comps. of the Dept., but while recognizing the difficulty about house accommodation, objected to the tone of Du Vernet's letter, and his assumption to speak for the rest of the Department[1] [166].

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[1] DDn. 435 (11-4), 17-3-41. [2] DDn. 326 (304½), 23-6-37. [3] DDn. 402 (7-9), 29-2-40. [4] SG. and Renny reached Kaliānpur, Sironj, Nov. 1840 [100]. [5] DDn. 435 (11-4), 17-3-41. [6] DDn. 402 (130-1), 18-3-41. [7] DDn. 435 (112-9), 5-8-42.

Du Vernet made better progress his second season and recessed at Hāthīpaon during 1843, when Everest recdd. him for promotion to 1st Asst., on Rs. 618 a month, refusing to spare him for the newly formed canal dept. of Sind [70–1, 246].

Promoted 14–6–44, Du Vernet continued work in the GTS. for the next ten years, but never became a precise observer, being more interested in the topo. work. He found it difficult to work under Waugh, and after tr. to principal trgn. in Assam, resd. in 1853, for tr. to Telegraphs in Burma.

EGERTON, John Francis. Ben. Art.

b. 10–8–10. d. Ferozepore, 23–1–46, of wounds received at battle of Ferozeshāh; MI.

2/Lt. 16–8–26 ... Capt. 3–7–45.

Son of Rev. Sir Philip Grey-Egerton, 9th Bart; rector of Tarporley, and Rebecca his wife, dau. of Josias Du Pré, of Wilton Park, Bucks.

ed. Addiscombe, 1824–6; no record of marriage.

RAS (*mn.*), VII (198); Hodson, II (125); *Punjab Inscpns.* (99–100).

22–12–35, appd. Rev. Survr., *pargana* Pharkaya, Monghyr, extending into Bhāgalpur [178, 183–4].

Sept. 1838, tr. to *pargana* Hijli, of Midnapore Dist. [186 n.1, 189 n.3], where ill-health compelled him to take leave to Europe, 8–8–39 [186, 189–91, 208, 347, 364–5, 368].

9–9–36, submitted from Monghyr a "Survey Calculation Table", a form of "traverse table". Though the Mil. Bd. declined to pub. it officially as Boileau's Tables had already been adopted in Western Provinces, Egerton's tables were printed, and used by some rev. survrs[2]. [232, 422].

ELLIS, George. Ben. Art.

b. Cawnpore, 15–4–06.
d. Mussoorie, 26–11–43.

2/Lt. 6–6–23 ... Capt. 22–2–41.

Son of Robert Ellis, of Boulogne, Col. of 25th Lt. Dragoons, and Eliza his wife.

m., Benares, 18–11–34, Anne Charlotte, dau. of Lt.-Gen. Charles Boyé, Bo. Inf.

ed. Addiscombe, 1821–3. Hodson, II (131–2).

17–1–37, appd. to ch. rev. svys. in Monghyr, and later to Bhāgalpur and Rājmahāl [178, 183–4, 347, 364–5].

Oct. 1840, tr. to ch. of svy. in Upper Assam, but on the journey reported sick, Gauhāti, 15–11–40, and granted 4 mo. leave; extended on mc. to the Cape for 2 years from 1–3–41[3] [204, 368].

EVEREST, George [II, 396; III, 441–6]
Ben. Art.

b. Greenwich, 4–7–1790;
bapt., St. Alphege ch., 27–1–1791.
d. Bayswater, 1–12–66[4]

Lieut. 4–4–06; Capt. 1–9–18; Maj. 25–7–32; Lt Col. 7–3–38; ret. 16–12–43; Hon. Col. 28–11–54.

STS. 1823–43; SG. 1830–43 [314].

2nd son of Lucetta Mary and Wm. Tristram Everest, solicitor to both Greenwich and Chelsea Hosps., who owned an estate and built house at Gwernvale, nr. Crickhowell, co. Brecon. Their 5 sons were b. at Greenwich [III, 441 n.3]. Of these the 3rd., Robt. [442–3], was army chpn. in India; the one dau., who never married, bred Shetland ponies.

Geo. m., 17–11–46, Emma, dau. of Thos. Wing, barr. of Gray's Inn; she d., 1890; their eld. son and last surviving descendant[5], Lancelot Feilding Everest, b. 28–5–53, d. Hampstead, 1–4–1935, leaving unpub. memo. on his father, quoted here under ref. LFE.; this records that the family pronounced the name Eve-rest [viii].

ed. RMC., Marlow and RMA., Woolwich.

FRS., 8–3–27; FRAS.; FRAS SOC.; FRGS., founder member 1830, VP. 1863–5; FRIGB.[6]; CB., 26–2–61; Kt., 13–3–61[7].

DNB.: *DIB.*; *Ency Brit.*; Markham (83–95, 101); *RS Progs.*, XVI, 1867–8 (xi–xiv); *RAS* (*mn.*), XXVII (105–8); *JRGS.*, 37 (cxv–viii); *RGS. Progs.*, XI, 1867 (185–8); *ASB. Progs.*, 1868 (25–6); Hodson, II (145); LFE.

Auth. of *Account of the Measurement of an Arc of the Meridian*, London, 1830—*Account of the Measurement of Two Sections of the Meridional Arc of India*, London, 1847—*A Series of Letters addressed to H.R.H. the Duke of Sussex*, London, 1839—Address *On the Geodetical Operations in India*, British Association, 1844.

Arrd. India, 11–7–06; on mil. service in Java, making occasional svys., 1812–6 [II, 137–8].

March to Sept. 1817, cleared for nvgn. Bengal rivers Ichāmati and Mātābhānga — 1817–8, on svy. for visual telegraph Calcutta to Chunār [III, 268–72] — Oct. to Dec., survd. route Chunār to Hyderābād, where he joined Lambton 28–12–18, having been nominated 25–11–17 [III, 225, 353; IV, 330].

1819–20, on trgn. E. of Hdbd. [III, 229–32]—1820–2, leave on mc. to Cape, reporting on La Caille's arc [III, 443] — 1822–3 on trgn. longl. series to Sholāpur [III, 234–6].

1823, appd. STS. on Lambton's death [III, 308] — 1823–5, extended Gt. Arc from Berār to Sironj [III, 242–6].

BGO., 14–10–25, furl. on mc., sailing from Calcutta, 11–11–25 — deputed to supervise design and purchase of new insts. [III, 246, 260; IV, 45] — visited trig. svy. in Ireland — pub. acct. of his meast. of Gt. Arc, 1823–5 [III, 246, 257] — Memoir to CD. on conduct of svys. in India, Leamington, 20–10–29[8].

25–8–29, nominated SG. and STS. of India; left England June 1830, arrg. Calcutta 6–10–30 by ship *Cornwall* — assumed office 8th Oct. [I, 12, 314].

Employed Calcutta till Dec. 1832, organizing comp. office, workshop, fd. units [12–3, 351]—overhauled new insts. and devised others from old stock [136–47]—measd. base-line along Barrackpore road [48–50].

Wrote prof. papers on azimuth obsns., compensation bars, barometer pump [45–6, 95–6, 130, 138][9]; prepared table of degrees from his 1st Constants, *JASB.* II, May 1833 (271).

Obtained increase of salary from Rs. 1,500 to 1,800 on grounds of holding two posts, but refused special mil. rank. After long corr. obtained authority for boat allce. of rank—or equivalent—throughout absence from Calcutta [328–9].

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[1] DDn. 435 (100) 10–8–42. [2] B. to CD. 11–8–37 (10). Siddons points out errors in Egerton's *Tables*, DLR. 36/42 (168), 25–1–39. [3] BRC. 28–12–41 (38), amending appn. for leave to Darjeeling. [4] bur. St. Andrew's chyd. Hove Sussex; tombstone photo. in film *Epic of Everest*. 1954. [5] a gt. neph., Sir Geoffrey Taylor (b. 1886) is FRS. & Trin. Coll. Camb. [6] Fellow of Royal Institute of Great Britain. [7] Refused kt. hood on ret., waiting for CB. [8] BM. Addl. MS. 14380 (78); CM. 28–10–& 15–12–29. [9] *As R. XVII*, 1833 (93–106, 189–214); *Gleanings in Science*, III (125).

Dec. 1832, having sent new parties into the fd., and office by river for Mussoorie, left Calcutta by road with Wilcox, 24-12-32 [24, 142, 163, 474]. Picked up his bro. Robt. from Ghāzipur, reached Mirzāpur 1st Feb. and marched on 6th to inspect Budhon Series at Saugor [61, 314][1]. Then visited Rossenrode in Gwalior, and reached Agra about 10th April [24-5, 460 ; pl. 3].

This was his first visit to the country where he was to spend the next 8 years bringing the Gt. Arc 500 m. from Central India to Himālaya Mts., and he was now to select a line across Jumna plain, and site for base-line [25-6, 50 ; pl. 4].

Reached Mussoorie early May, before his office, and estd. himself at The Park, nr. Hāthipaon about 3 m. w. of Mussoorie, an estate bought from Gen. Whish [163 n.7, 439] in Dec. 1832. The house standing about 6,500 feet above the sea, became his summer hdqrs. for the next ten years [III, pl. 3 ; IV, 160, 320, 439-40].

Though his immediate interests lay with the GTS., and particularly the Gt. Arc., Everest was responsible for svys. of Madras and Bombay, and had already taken the Hdbd. topo. svy. and Bombay trig. svy. under his direct orders. He had no hdqrs. deputy ; De Penning looked after the Calcutta offices, and Morrison, the Regr. held ch. of the fd. office at Dehra Dūn [165].

Fd. season 1833-4 was of critical importance. Leaving Mussoorie 2-11-33, Everest selected site for base-line W. of Dehra, and then moved down to Agra to start detailed selection of stations for Gt. Arc. Sending Wilcox s.ward into Gwalior, he personally directed operations n.wards. Progress through hilly area was simple, but approaches to Delhi and the tree-covered plain to N., with atmosphere thick with dust and smoke, taxed all his ingenuity. Even with scaffolds for observer and inst., and poles for burning lights, the choosing of stations and the clearing of rays between them led to one disappointment after another [27-38].

> "The difficulties...[were] overcome...by unremitted patience and determined perseverance. The toil...was excessive on me in particular, for I not only had to direct the whole machinery, but to take all the observations myself, and, as these were chiefly between night-lights, my rest was interrupted at all hours. ...
>
> "On others the labour fell light in comparison, for when the period of after-midnight observations was over, whether in failure or success, all save myself retired. ... But...I had to...prepare fresh instructions to the out-parties for burning blue lights on the ensuing night—to see those letters sealed myself—and each distributed to one of the messengers paraded for the purpose, to whom I myself gave instructions. ...
>
> "My hours for meals were irregular, with those for sleep. Every personal comfort was thoroughly abandoned. ... Everything was made to give way...to the work of the approximate series. The business of the Surveyor General's Office was transacted...in such intervals as I could snatch, ... and... between the 16th December...until the 5th April...I never had one leisure hour[2]".

Intervisibility had at first to be tested by trial and error with blue lights burned at distant points on pre-arranged programme. Bad weather and intervening obstacles interrupted these programmes, and Everest's patience was sorely tried. He stung his best workers by caustic reproaches ; he poured out streams of biting words that could hardly have stimulated eager co-operation, but he never seemed to rouse resentment. He writes to Joseph Olliver, his oldest and most capable asst. ;

> "I really am at a loss how now to proceed. As to making blue lights sufficient to meet such a reckless and wanton expenditure, it is quite out of my power. I dare not put a blue light into the hands of any of you. You seem...to think they grow like grass, and that all you have to do is to put them at top of a pole and set fire to them, just as you would to a whisp of straw.
>
> "How...the work is to proceed I do not know. I suppose the only way is for me to go quietly into Meerut Cantonments and leave you to recover the use of your senses, for it seems you will not abide by my orders, but—pell mell—helter skelter—foul or fair—away go to damnation and destruction the only means we have of getting through our work.
>
> "You all seem to me to be right stark—staring—mad. Never was a worse evening. ... I could not see five miles in any direction. The sun was obscured at 4 o'clock, and by 5 there was not a vestige of him, and that is the kind of atmosphere in which you choose to burn blue lights.
>
> "Well—here we must remain. I have superseded Mr. Dove by Chitakatun [*khalāsi*], who I dare say will do right. I have sent out Mr. Keelan to charge take of the station from the Saini bedlamites. When I have done with these two stations, I shall be at leisure to turn my attention to you, and unless I received some assurance...that you will not play the fool in like manner again, I shall certainly adopt equally strong measures to you. I would rather avoid that, not only because I do not wish to mortify you, but because I am loth to do anything to bring into disrespect the character of my Chief Civil Assistant [27, 373-4][3]".

He writes again two nights later, but it may be wondered if poor Olliver appreciated a point that Everest obviously chuckled over ; "I give you credit for your good motives, but injudicious zeal is like what Captain S. tells us of the Esquimaux who, when one of their party was dying from a surfeit of eating walrus and lying helpless on the ground, stuffed him perforce with walrus fat, in order to prevent his being hungry, and killed him of course[4]".

Olliver must, indeed, have been the most patient of men, and he could hardly have endured a more crushing snub than Everest's reply to a suggestion that Rossenrode deserved some recognition for his excellent work, "I do not require to be reminded. Pray mind your own business[5]". After all, Rossenrode had been working directly under Olliver [58 n.3].

Work across the Jumna valley proceeded much better after the introduction of the ray-trace system, devised by Everest himself, that obviated the groping by trial-and-error [77-81]. In the end the results of the strenuous, hectic, work of the last four months had proved, writes Everest, "an unbounded success, which enabled me in a hand over hand style to bring the approximate series by the end of April finally up to the base-line traced out in the Dun in the preceding November ; and by the end of May to have every site selected, the necessary height of each tower determined, and two angles at least in every triangle actually measured[6]" [36-8].

The rains of 1834 were again spent at Hāthipaon, much of the time being spent on the design of towers to give obsn. over trees and buldings across the plain [82-3]. Everest would not have elaborate

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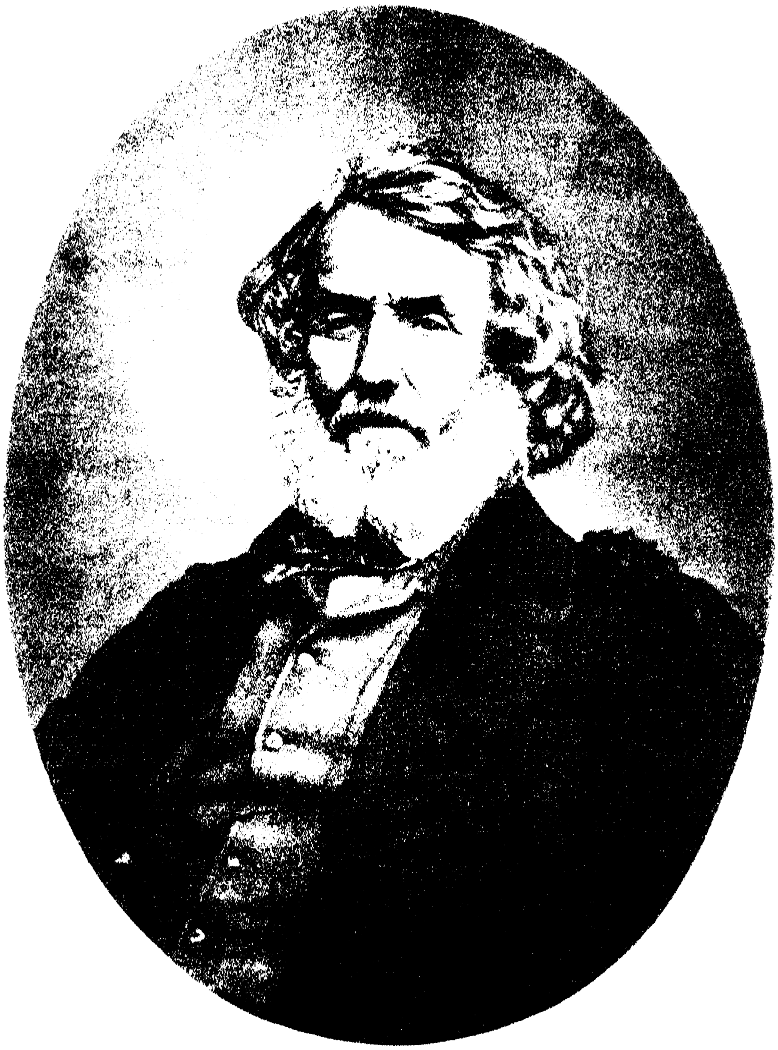
[1] Dates suggest several days stay at Ghāzipur. [2] Narr. 1833/4 (60-2). [3] DDn. 321 (174-5), Dholri, 3-3-34. [4] ib. (178-80), 5-3-34. [5] DDn. 173 (285-6), 12-6-32. [6] Narr. 1833/4 (45).



Geo Everest

GEORGE EVEREST
1790-1866

BENGAL ARTILLERY: COLONEL: F.R.S.; C.B.; KT.
SUPERINTENDENT, GREAT TRIGONOMETRICAL SURVEY 1823-5.
SURVEYOR GENERAL OF INDIA AND S.T.S. 1830-43 (II.396; III.441-6)

FROM A PHOTOGRAPH TAKEN IN LONDON
PROBABLY ABOUT 1860

staircases; "We of the Trigonometrical Survey are used to ascend by common ladders, and are quite ready to undergo a little personal inconvenience rather than put the State to expense[1]".

At the close of the rains he made a long-planned trip into the hills, fixing stations at Nāg Tiba, 31st Aug. to 5th Sept.—Kedarkanta, *c.* 12,540 feet, 17th to 23rd Sept.—Chaur peak, 4th to 10th Oct. 1834. He took obsns. to snow peaks and sketched their profile, and described the rocks, plants, and trees at his hill stations [38].

Godfrey Vigne [472] tells of meeting him on the Chaur; 'I started [from Simla] across the mountains for Mussoorie. ... On the way...my companion and myself received an invitation from Major Everest, Surveyor General of India, at that time on the Chur, conducting the grand trigonometrical survey, and of whose hospitality I shall ever retain a grateful recollection. ...

"The camp of our host was perched as near as possible on the very top[2], and our chief object was to keep ourselves warm. The tent in which we dined was furnished with a...stove, and the entrance carefully closed against air, whilst we drank our wine, and talked to a late hour above the clouds.

"On the huge granite rocks that formed the very apex of the mountain, the labourers in attendance had formed a platform of loose stones, ... and in the center they had planted a mast as a mark for the survey. Several that they had previously raised on other summits were visible only by the aid of the theodolite, and a powerful heliotrope (in use at Saharanpur in the plains) might...have reflected the sun's rays towards us from a distance of sixty miles.

"I can never forget the glorious view of the snowy range, some sixty or seventy miles from us...as the morning broke over the sacred peaks of Jumnutri and Gangutri. ...

"The entire range of the Himalaya—upon whose most elevated pinnacles (20–25,000 feet) the rose-coloured light seemed to pause before it ventured into the yet gloomy atmosphere to the southward of it—was extended from west to east as far as the eye could reach, rearing itself high and magnificently above the great valleys at its base like the turbulent billows of an inland sea[3]".

During the cold weather of 1834–5, Everest had several petty disputes with Col. Young, Supt. of the Dūn, about official matters, but otherwise their relations were most friendly [167–70]. The season was spent on the meast of the base line[4] and its connection with surrounding stations [50–2], but before operations were completed Everest became seriously ill [315].

"Early in January my health had shewn symptoms of deterioration which...would probably have yielded to timely rest and special treatment, but as I felt... the necessity of continuing to direct...the operations in person, those symptoms gradually grew worse. On the 18th February I was confined to my bed, utterly deprived of the use of my left thigh, and with every prospect...of an inflammation in the hip joint, which would render me a cripple for life, even if it did not bring me speedily to the grave [III, 444]. ...

"To the astonishment of my medical attendants, ... after the application of some hundreds of leeches—fomentations administered night and day for several days in succession—a due abstraction of blood from cupping—and a course of gruel diet—I began to recover the use of the limb, and by the end of February was again able to walk about.

"Admonition was now given...by Doctors Gray and Falconer [170]...that I had had a fortunate escape, ... that I must quit the field immediately, and absolutely abstain from further exertion. ... They meant me well...but the predisposing cause of my illness...was mental anxiety respecting...the gigantic undertaking which I had in hand. ...

"I proceeded...to complete the small triangulation...and.. to connect the two ends of the base with...Amsot and Banog [39, 52; pl. 4], incurring a second attack of my illness severer than the first, a third severer than the second, and a fourth still more appalling than any that had preceded it. I was confined to my bed from May to the end of October with little intermission, during which I was once bled to fainting, had upwards of 1,000 leeches, 30 to 40 cupping glasses, 3 or 4 blisters, ... besides daily doses of nauseous medicine, ... all of which produced such a degree of debility as to make it of small apparent moment whether I lived or died[5]".

By Oct. 1835 he was so far recovered from what was undoubtedly a type of malignant malaria as to make preparations for taking the fd., and carrying through the actual obsn. of the triangles. He took the precaution first, however, to warn Govt. of the precarious state of his health, and the need to have someone ready to take up the work in case of his own break-down. He asked permission to take his senr. asst., Andrew Waugh, with him to that end. He considered it "a sacrifice I owed to my brother who was then my guest, and to my other relations, to promise that at the first assured aspect of...danger I would withdraw from the field [5, 315]. ...

"I have survived the storm[6]". The news reached London [317, 437].

It is not surprising that many of the SG.'s letters of this period were irritable, and after some particularly savage letters to De Penning, Everest felt constrained to make amends; "I was nervous and worried when I wrote about the large theodolite [142]. Think no more of it. If you had said half a dozen words...I would never have said anything of the kind. ... So! So! let us be at peace again[7]".

Waugh joined him on the Gt. Arc, Jan. 1836[430], and obsns. were completed to s. of the Chambal into Gwalior State [40, 473]. Season 1836–7 started with an unfortunate delay of more than two weeks at Dholpur on the Gwalior frontier. Everest had written some time ahead to ask that he should be met by State officials with suitable escort, as there had in the past been robberies and difficulties over supplies. The Durbar had, however, sent no one to meet him on the border, intending to provide all that was wanted on his arrival at the capital.

Everest was indignant, and refused to cross into Gwalior without due ceremony. He wrote angry letters to the Resdt. who not only refuse to interfere, but went off into camp. Everest then broke all rules by writing direct to the *durbar*. For this he was reprimanded by the Supreme Govt. but he gained his point, and was received across the Chambal with ceremony [154–6].

His stubborn persistence in a matter that might have been eased by a little tact and surrender, and his most discourteous letters to the Resdt. were characteristic. His obstinancy and his love of bitter phrases brought him into constant trouble, and yet—he brought his great task to a successful completion, and won the respect of all, and the affection of his immediate staff, always excepting that of Henry Barrow [417–9], and Robt. Shortrede [465–7].

With the help of Waugh and Jones trgn. was closed at Sironj, and Everest returned to Kaliāna, some 40 m. N. of Meerut, to try out Troughton's circles that were to be used for obsn. of zenith distances. To his horror he found they lacked the rigidity that would be essential for precise work. Though they had been more than five years in the country, this was his first opportunity of putting them to the test. He decided to reconstruct them at once [131–5]. Barrow was called up from Calcutta and started on the work at Kaliāna in Oct. 1837, before Everest marched to Sironj himself to conduct the remeast. of the base-line there.

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[1] DDn. 289 (10–24), 13–3–34. [2] 11,966 ft.; RHP. built a metl. obsy. nr. the top in 1902. [3] Vigne, I (34–7). [4] with another visit from Vigne [52]. [5] Narr. 1835 (19–20). [6] DDn. 286 (223–66), 31–10–35, cf. *GTS.*, II (viii-A). [7] DDn. 315 (106–9), 21–9–35.

Once again he was taken ill ; "I have since the 10th November been labouring under a severe attack...which...still confines me to my bed, but my astronomical assistant [Waugh] is so able and zealous, and my subordinates are so thoroughly trained...and actuated by so admirable a spirit, that this will make no difference in the progress of the work[1]" [41, 53].

The trouble passed, the base was measd., and he got back to Kaliāna, 9–3–38, to speed up the work on the astr. circles, which he brought up to Hāthipaon in May for better supervision. Barrow chafed continually under this close control, and eventually refused to complete the work on Everest's design, and welcomed his discharge [132–4, 418–9].

Everest was promoted Lt Col. in March 1838, and it is hoped that he appreciated the ribald letters of his friend Thos. Lumsden, of the Fatehgarh Ordnance Depot [130] ;

20–1–39, "I am sorry to hear you have been so unwell, but trust this cold fine weather may quite restore you to health. In your anxiety to keep a sharp look-out after the heavenly bodies, don't forget the comforts necessary to keep body and soul together in this lower world".

12–3–38. "I am very glad to hear your operations are going on in so satisfactory a manner and, as I expect to see you promoted very shortly in the room of Frith, I hope you will then be enabled to drop your survey with your commission, and make way for others, who will make way for me, as I am sure most of the Majors, and all above them, have been too long in India already"[2].

"Have you...any idea of going home soon after your promotion ? ... Had I not so large a family depending on me, I would be off...at the close of this year, but I am afraid to encounter the heavy expence of bringing forward a troop of children without being quite sure of...adequate funds[3]".

Everest's illness at Sironj determined him to get an asst. to help with the heavy office work [316–7, 325]. He met the GG., Lord Auckland, at Sahāranpur in March, and impressed on him the urgent need for such asstce. He called for med. opinion [176] ;

"I was attacked in November last near Sironj with a severe illness. ... Dreadful rheumatic pains in my bones—fever—loss of appetite—indigestion—intestines totally deranged—stomach totally powerless—my strength entirely gone—the whole system apparently destroyed and for ever undermined[4].

"I recovered gradually...but found to my indescribable dismay that my memory was in a great measure gone—that my mind was affected—that whatever I did or thought of during the day preyed on me at night—and worst of all I found myself oppressed by a dreadful foreboding of ill—a horror of being awake in the dark—an apprehension, even whilst I was wide awake, of some spectre or monster of the fancy coming to hold converse with me. ...

"I thought it would have certainly ended in madness. Indeed I have little doubt it would have...if I had not come to a better climate, and foresworn business to a great extent. ...

"It is plain...that I must be relieved by having some able assistant to take from my shoulders the great mass of office drudgery, or that I must resign my situation temporarily by going to the Cape, or permanently by going to England. ...

"Except in-as-far-as the work of the Great Arc is concerned, I would not stay in India on any account. ... I have attained the rank I want, and more rank or more money... would only be a burden to me[5]".

Dr. Gray produced the cert. asked for—full of the most harrowing details—and concluded, "It pains me to see a mind once so powerful should be so impaired, ... and an irritability of temper...quite unusual. ... His mind chiefly, as well as his body, requires absolute rest from his arduous duties, or a return to his native country is not far distant"[6].

As a result of all his efforts Bedford was put in ch. of the Calcutta offices as DSG. [325], whilst Bontein joined at Dehra as ASG. [326–7].

Though Everest had abjured all desire for higher rank or "more money", he was not above pressing to be made a Companion of the Bath. He submitted a list of 22 brother officers of the Company's service who had been so honoured, "and is grieved to find that his name is not in the list. ... It is sometimes said that Philosophers and Men of Science should be above such baubles and trifles as honorary distinctions, but, ... of all weaknesses to which man is subject, that of affecting to be above the passions...of human nature is the vainest and most futile"[7].

The Directors forwarded his memorial "for consideration in the proper quarter", but the desired "bauble" did not fall to him till more than 20 years later [433].

It was not until 1839 that he obtained sanction to construct a temporary obsy. and a workshop at Hāthipaon. He pointed out the need for training his assts., and for special drill in astr. obsns. in preparation for the zenith distance programme [99]. It would be wrong to take up valuable time in the cold weather, and, on the other hand, "after the 15th of April the dust and hot winds in the doab are sufficient to destroy all delicate instruments, ... and to crack or permanently change the figure of the levels.

"In the rainy season no observations can be made. Wherever the instruction, ... I must be the instructor, and, as to my remaining in the plains after the middle of April, unless I could sleep all day long, and all night too, it is...an utter impossibility. ... To do any kind of work, or have any symptoms of energy about me, mental or bodily, is...out of the question, for I have tried it more than once, and suffered great penance as the result.

"The probable issue of such an experiment would be that before the end of June I should be either in my grave, or on my way to sea for the recovery of my health, and the work of instruction in either case would be just where it was"[8].

This letter was written just after he had got rid of Barrow after three very difficult months at Kaliāna [123–4, 133–4, 418–9], and the workshop was required for the graduation of the new circles with the help of Waugh and Mohsin Husain [131–5, 458]. This was to be followed by combined astr. obsns. at Kaliāna, Kaliānpur, and Damargida during the next two fd. seasons [96–101]. Then at last he would be free to go ;

"The completion of this measurement will close my career in India, and I shall feel grateful if His Lordship will give explicit instructions to the Accountant General...that... I may be at liberty to proceed to Bombay, and thence by the overland route through Egypt to England [320]. The date of completion will, I hope, be in the first days of February 1842, and it is my present intention to retire at that period".

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[1] DDn. 342 (64–6), 1–12–37. [2] Everest was 4 years senr. to Lumsden on Art. list. [3] DDn. 347 (23, 69). [4] He reached the ripe age of 75, with 23 y. in healthy retirement. [5] to Dr. Gray, DDn. 348 (228–30), 7–6–38. [6] DDn. 347 (154–7), 9–6–38. [7] DDn. 342 (257–9), 18–11–38. [8] DDn. 344 (26–9), 4–3–39.

To provide against any recurrence of his old troubles, he arranged for the company of Thos. Renny, for it was essential that the series of obsns. at each end of the arc should be simultaneous; reliance could not be placed on one observer alone. He abandoned his first proposal to march south from Kaliānpur in Jan. 1841 to recess at Ootacamund and take up the re-meast. of the Bidar base-line later in the year[1]. He returned from Kaliānpur to Mussoorie, and left Waugh to complete the programme to the south [43–55, 473].

The astr. obsns. at Kaliānpur during season 1840–1, were the last fd. operations in which Everest took a personal share, and Waugh's re-meast. of the base-line closed all fd. work on the Gt. Arc [55–6]. From May 1841 till his departure for Calcutta in Sept. 1843 Everest was, with a few short intervals, deeply engaged in working up his geodetic results, preparing his prof. reports [100–4], and wrestling with Govt. over the future programme [17–22].

Govt. had at times shewn impatience with Everest's repeated requests for the revision of old work on the Gt. Arc to the higher standard now followed. During 1840 a lengthy corr. sprang up in which Govt. pressed for an early conclusion and speedy pubn. of results to serve new svys. and mapping. The moving spirit of this impatience was Henry Prinsep, Presdt. of the EIC.'s "Survey" or "Geographical" Committee [II, 297–302, 318].

Though constrained to issue preliminary figures [101–4] Everest only did so after strong protest, pointing out the Directors' desire for the highest accuracy. His letters were extremely long—full of technical explanations and arguments—and personal appeals, possibly exaggerated. Thus, "Though eight years have elapsed" since submitting his programme in 1832 [13], "I am still in India, and resolved, if I live, to bring the Great Arc to the honourable termination which I then contemplated. ... Since the date of the letter cited, I have suffered two exceedingly severe attacks of illness which have endangered my life.

"Age has begun to leave the usual indelible marks upon me [now 49 years]. My eyesight, once so vigorous, is failing me fast. I have...habitual attacks of gout and indigestion. My native energy and activity are forsaking me, ... so that I am equal to but little exertion, and that little is daily becoming less. ... It is indeed better that I should quit active life at the termination of the base-line, ... and to leave the field work for younger men, who will be better able to do justice to it by their activity"[2].

Throughout his worries and illhealth, his old friend De Penning was always sympathetic and helpful, and he writes to Kaliānpur in Dec. 1840, when Everest was again laid up, that he was "sorry to learn...that your old adversary the gout has again renewed acquaintance with you. ... Give him no encouragement, ... and, as there is no further necessity for marching, ... lay yourself up quietly keeping yourself snug and warm. I believe there is something unhealthy about that place Kalianpur. ... The merino vests and drawers, a dozen of each, have been despatched to...Sironje by yesterday's dawk bangy, packed up in four tin cases and, [I] hope they will reach you in time for this cold season"[3].

During the last two years Everest's outlook had been clouded by the activities of Thos. Jervis, who had, 2-9-37, been appd. "Provisional Surveyor General of India" [317, 450]. Not only had the Directors been disturbed by alarming accounts of Everest's illness during 1835 [435], but they had been much impressed by the glowing accounts from Bombay of Jervis's talents and still more by the self-confidence and assurance he displayed during his visit to England [449–50].

No record has been found of the Govt. of India being officially consulted in the matter, nor of any reference to Everest himself, except as a *fait accompli*. Jervis himself accepted it as a fitting recognition of his talents, and his biographer records that when he went on furl. in 1836 "he had been elected Fellow of the Royal Society in consideration of a paper on Weights & Measures, and was soon after elected Fellow of the Royal Astronomical, the Royal Geographical, the Geological, and the Royal Asiatic Societies. ... In recognition of his unremitting enthusiasm, he could not longer be kept in the background. The Bombay Government had reported highly of him, ... and at the recommendation of the first scientific men of the time...the Court of Directors, to whom he had now become personally known[4], appointed him provisionally Surveyor General of India, to succeed on the retirement of Major Everest, at that time at the apogee of his fame, though so physically broken down by ill-health that it was considered likely to necessitate his leaving India"[5].

The appt. was surprising for Jervis had no qualifications as geodesist, and his trgn. of the Konkan was extremely sketchy [III, 203–2]. He was the last man the Directors should have chosen if they wanted their Atlas of India and future svys. based on a truly scientific trig. svy. This was the task entrusted to Everest, on which he was straining every nerve to ensure unimpeachable precision, and on which there were nearly five years fd. work yet to be carried through. We do not know the exact occasion when this appt. was first communicated to Everest, nor do we know his immediate response, but the shock was severe.

He was not in a position to protest, for in communicating the appt. to India, the Directors made it clear "that, so long as I remained in office they must look to me alone as their responsible adviser in all matters connected with the survey of India, and further paid me the handsome compliment of saying that—although under the apprehension that my health would compel my early return to England they...made a provisional appointment of a successor—yet, as they had not since received tidings confirmatory of that apprehension, they were in hopes that the Government would have the prolonged advantage of my services"[6].

He really was aroused, however, when Jervis sent him towards the end of 1838 a pamphlet printed at Torquay "for private circulation" which contained the following papers[7]:

i. *Proceedings of the British Association*, 26-8-38, Newcastle; Section C; Geology & Geography; comprising a long rambling address by Jervis on the development of geography in India from the days of Rennell, and the possibilities of future progress.

It made gracious ref. to "my distinguished predecessors, ... and to crown the list, ... the names of Lambton and Everest. To the two latter we are indebted for all that is worthy of note as regards Geodesy. ... This grand scientific enterprise [Gt. Arc]...has been...continued with unwearied resolution and ability by Colonel Geo. Everest, and is now on the eve of completion, ... some few celestial observations only remaining to complete the greatest, and probably the most accurate, service of the kind that has ever yet been... attempted"[8] [450].

ii. and iii. Letters from Wm. Tate [III, 500] and David Scott [III, 501], appreciating the good work of Indian survrs. on Bombay and Assam rev. svys.

iv. A resn. by the British Association dated 27-8-38, the day following Jervis's address, advocating a programme of geodetic and geogl. work in India, to be brought to the notice of the EIC.

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[1] DDn. 433 (108–84), 3-8-39. [2] DDn. 402 (57–81), 24-7-40, para 63. [3] DDn. 307 (245–57), 12-12-40 & 3-2-41.
[4] Chmn. EIC. 1836-7, Maj. Sir James Rivett-Carnac, of Bo. Inf.; Govr. Bombay, 1838-41. [5] Jervis (46–7). [6] Everest (10).
[7] quoted here under ref. "Thos. Jervis"; *v. Bo Geo. Soc.* 1840 (157–89); *JRGS.*, VII (127–42). [8] Thos. Jervis (15–6).

v. A letter from the Hydrgr. to the Admiralty quoting unfavourable comments on Walker's Atlas of India, and insisting that a good map of India could only be produced under the direction of the officer directing the surveys [III, 285; IV, 304].

vi. Letter dated 26-6-38, from Col. Colby, Supt. OS., Gt. Britain and Ireland, describing the freedom allowed him in the selection and advancement of his officers.

vii. Extract from report by Lambton of 1822 on the work of the GTS.

viii. An address, 14-7-38, from the Royal Soc., the Geological Soc., and the Royal Geographical Soc., sd. by H.R.H. the Duke of Sussex[1], Presdt. RS., referring to Jervis "who has recently been appointed by the Honourable Court to the charge and superintendence of the great survey of India". It set out the course in which the svys. should be developed, and recdd. that Jervis "should avail himself of the advice and aid of Sir John Herschel, Mr. Baily, and Mr. Airy".

ix. Letter dated 6-8-38 from Jervis to CD., ref. above address, setting out his personal views on the svy. of India, and expressing no doubt of his early assumption of duty as SG. "In appointing me to this arduous and responsible office, the Honourable Court may rest satisfied they have made no injudicious choice".

x. "Memorandum of the preliminary measures recommended by Major Jervis to expedite and complete the great survey of India".

xi. Facsimile of the address, 14-7-38 (viii above), with the 39 signatures which included many distinguished names.

This copy of the pamphlet, since bound with Everest's retort [442] bears on fly-leaf an inscription in Jervis's handwriting; "To Lieut.-Colonel Geo. Everest, F.R.S., Surveyor General of India, with Major T. B. Jervis' respects". It contains numerous pencil annotations in Everest's hand. It is unlikely to have been sent to press before the end of Sept. 1838, or to have reached Everest before March 1839.

Everest was furious, more particularly against the RS., of which he was himself a Fellow[2], which had completely ignored him, counting Jervis as already *de facto* SG.; in their address of 4 printed pages (viii above), Everest's name appears but twice.

He retorted by a series of ten letters[3] addressed to the Duke of Sussex, PRS., who had sd. the address, and taunted him and his co-signatories for having been so completely fooled by Jervis, and for their abysmal ignorance of everything connected with India and its surveys. Letter III was written "in camp and far from my headquarters and library", possibly at Kaliāna when struggling with the astr. circles [131-5]. Letter VII was written in Mussoorie, a few short months after Feb. 1839, when the Army of the Indus "crossed that classic river[4]" [281-2].

These letters obviously gave him intense satisfaction and, knowing his impetuous nature, it is reasonable to conclude that he despatched each one as soon as it was written. But the whole collection reached England in time to be printed and pub. in London before Oct. 1839[5], by Wm. Pickering, the title-page describing them as "remonstrating against the conduct of that learned body" the RS.

In a brief preface to "the public" Everest hopes that "there may not be wanting those who, on the bare principle of justice, will consent to peruse the present series of letters; and who make it the rule of their lives to frown down the strong when combining to oppress the weak and the absent. ... I ask no advocate—I court no favour—I complain of wrong inflicted by a body of men, powerful from their influence, their learning, their rank; and all that I ask is a fair and impartial hearing".

Letter I opens; "A pamphlet has recently fallen under my eye, written by Major Jervis, ... with which is bound up amongst several other documents one purporting to be an address to the Chairman...of the E.I. Company, bearing the signatures of many of my countrymen most distinguished for their attainments in science, and at the head of them that of your Royal Highness as President of the Royal Society".

After pointing out that some of these gentlemen had recd. presentation copies of his pub. *Account of the measurement of An Arc*, he proceeds; "If then in that address I find myself treated as a thing gone by and unworthy of further note, ... I have just cause to complain, and though there are certainly no direct symptoms of positive disrespect where my former labours are alluded to, yet to my present labours...not only is no allusion made, but the gentleman selected by my employers to succeed, only...*in case of my being compelled by ill-health to leave India*, is spoken of as already installed, and I as out of office". He quoted the Directors' hope that his services would long be available to them in India, and "I need not point out how utterly at variance it is with that assumed as the basis of the Address of the Royal Society[6]".

The letters are full of bitterness and satire, but they are of great historic importance, for, in justifying his work, he gives many precise details that are not recorded elsewhere.

It is to be noted that the Duke ceased to be PRS. on 30-11-38, and that no copy of these letters is now with the RS.

Meanwhile Jervis had been pressing for recognition of his svy. of the Konkan as material for the Atlas [307-8], and persuaded the Directors to call for the maps which he had left with the DSG. Bombay. It was with some relish that Everest reported that he could not possibly undertake to prepare them for the Atlas, as the trgn. on which they were based was of the most inferior character. He returned them to Calcutta with the suggestion that Jervis himself was the best man to undertake their compilation [308, 453].

Jervis returned to India towards the end of 1839, greatly uplifted by his success in England, and full of eagerness to step into Everest's shoes. He wrote to him on 13th Dec., and Everest replies, 30-12-39, from Kaliāna, where he was in the middle of his first series of obsns. for zenith distance [99];

"My dear Sir, I was duly favoured with your letter of the 13th inst. and its enclosures. ... I fear it will disappoint you, but nothing whatever will move me from my post until the whole arc to the north of Beder is completed so as to be invulnerable to all imputations of inaccuracy. The triangulation has all been done in a style of surpassing excellence with first-rate instruments, and, as my *amour propre* leads me to hope, by observers second to none. ... My invaluable astronomical assistant, Lieutenant Waugh, is now at Kalianpur, ... whilst I am at Kaliana. ...

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[1] Aug. Frdk. (1773-1843), 6th son of Geo. III; PRS. 1830-9; *DNB.*; *RAS.* (*mn*), VI (27); in 1880 BM. purchased copy presented by Jervis to Bishop of London.

[2] later to join Council.

[3] quoted here under ref. "Everest"; cf. Markham (91-2).

[4] Everest (20, 78); Thos Jervis (Maps, 84).

[5] BM. recd. copyright copy 19-10-39.

[6] Everest (1, 4, 10).

"From this you will able to judge of my plans, and form your own. ... I am well mindful of what Solomon says; 'Hope deferred maketh the heart sick', and can...sympathise with the annoyance it must cause you to find me so pertinaceously continuing to occupy the station which you were led to suppose was vacant; but my mind is made up to complete before I go all the work of the Great Arc. ...

"Obtain the sanction of Sir J. Carnac [437 n.4] to come here on business. Come and stay with me. ... I shall be very happy to give you a hospitable reception—most delighted to introduce you to all the arcana of my department—to show you the implements, both personal and material, with which you will have to deal. ... If you start from Bombay immediately after this reaches you...you will be in our mountains before the hot winds set in and I do assure you there is not a nicer climate anywhere.

"It is in truth high time that you and I were better acquainted. ... I am very anxious to have some conversation with you regarding my scientific acquaintances in England and to hear all about the Astronomical Society, and the Royal, and Sir J. South [III, 406, 532] and Professor Airy [113 n.2], and so many people who are interesting to you and me[1].

This letter is written in so cheerful a vein that Everest had probably long disposed of his *Letters to the Duke of Sussex*, and was satisfied that Jervis would never attain his ambition. He writes to the Marquis of Northampton, who had succeeded as PRS., "I shall perhaps be recognized as the author of a series of letters addressed to His Royal Highness the Duke of Sussex, of which I directed my printer to send you a copy for your acceptance"[2].

What finally persuaded Jervis to abandon hope was Everest's discovery that he would not be entitled to a colonel's pension before the end of 1843. This Everest communicated to him in Aug. 1841, and Jervis left India on the plea of ill-health four months later [317 8, 450].

At the end of the rains of 1841 Everest marched across the hills from Mussoorie to Simla to make official calls, and inspect Boileau's magnetic obsy. [118]. He writes to the PA. at Sabāthu, 27-9-41; "I propose setting out tomorrow morning. The list of stages and detail of the establishment...will be...as...specified [174]. ... I expect to cross the Tonse on the 5th, and to arrive at Simla on the 12th October. I propose remaining a space of 6 or 8 days at Simla, and...proceeding into the territories of the Rajahs of Jhubal and Bischar to visit some stations of the G.T. Survey". The elder James accd. him and took trgl. obsns.[3].

An incident occurred on the way that roused all his old fire. Thakur Jograj reported to the PA. that "the Surveyor General having arrived at the chowky of Dhai from Mussoorie, I immediately...sent...grain, wood, grass, sheep, fowls, etc., ... and...placed one of my people at the chowky of Patanalla[4] to send intelligence of the arrival of this gentleman within my territory".

He complained that Everest's followers had befouled his private orchard, destroyed a dog, and been abusive when paying for coolies. Everest was thoroughly roused, and admitted in heated corr. addressed to the PA. that there was "a general order in my camp which has existed from time immemorial [III, 445] that all dogs, cats, and other vermin infesting my camp, which prowl about in search of what they can devour—cannot be driven away—and are apparently without owners—are to be shot, hung, or otherwise destroyed as public nuisances, and it is probable that some dog may have met this fate...on the night of the 10th October. ... But, if this be the sort of dog of whose fate the Thakur complains, permit me to ask by what right he lets such animals loose to prey upon travellers?[5]".

It is extraordinary, but very typical, that Everest should have spent so much time, heat, and sparkle, as he did in these letters, in dealing so savagely with such a trivial matter. He could not bear to be unfairly accused. He loved exercising his pen, however unworthy the occasion.

Among his chief occupations during his last two years in India were—the completion of compns. and charts connected with the Gt. Arc—settlement of programme for GTS. on lines proposed in 1831, in form of merdl. chains of triangles crossing Ganges valley at one degree apart, successfully resisting a proposal to double the interval [20-2]. His crowning satisfaction was the acceptance of his trusted asst. Andrew Waugh to succeed in the double office of SG. and STS. [II, 318-9, 473-4].

Early in 1843 he inspected his fd. parties in Rohilkhand, and visited Naini Tāl [71, 320].

It was with deep regret that in Sept. 1843 Everest closed down his residence at the Park, which had been his hdqrs. for 10 consecutive seasons [III, pl. 3; IV, 163-6]. In 1838 the enterprising Fanny Parks paid several visits to The Park and beyond, where Edmund Swetenham[6] owned "an estate in the hills called Cloud End, a beautiful mountain of about sixty acres covered with oak trees, between ...a hill called The Park and Ben Oge. ...

23-8-38. "Colonel Everest has a fine estate near Bhadraj[7] [III, 34; pl. 5 n.; IV, 164] called 'The Park'. I rode over with a most agreeable party to breakfast there this morning, and to arrange about some boundaries. ... Boundaries in the hills are determined, not by landmarks, but by the fall of rain. In the division of a mountain all the land is yours down which the rainwater runs on your side, and on the opposite side all the land is your neighbour's over which the water makes its way downwards.

"Colonel Everest is making a road [164]—a most scientific affair—the obstacles to be conquered are great, levelling rock and filling up khuds[8]. The Park is the finest estate in the hills[9]".

At Everest's request his boundary had been defined in 1833, Morrison reporting that "Colonel Young's people have been here, and have made what they call a measurement of Park House Estate; by their reckoning it contains 850 pucka or 2,550 kutcha biggahs, ... about 283 English acres. The boundary on the Badraj side is defined by the private path leading from the Park to the Pioneer Road [463]. On the Masuri side the boundary commences at a tree...towards Lieut. Tweedale's house[10]. From this tree the Park boundary is supposed to run in a direct line across the dell or khud by the base of Hati Paon towards Dehra. On the Dehra side the precipitous dell below the Badraj range and Banog is the limit to your estate"[11].

In 1841, following Brown's rev. svy. of the Dūn, and in anticipation of his estate svy. of Mussoorie [220-1], Everest approached the Supt. of the Dūn for confirmation of his ownership. Under the new settlement all village waste lands were to be considered Govt. land, and under Brown's svy. the area of the Park Estate was taken as 640 acres, less 70 tr. to Peyton's property.

Everest was anxious to have his ownership registered for its ready disposal after his departure. He writes to the Supt., 23-4-42; "The estate called The Park was first taken possession of by Col. Whish in May 1829 [163, 434]. It is in the waste land...of Rikholi [III, pl. 3]. ... The rent was fixed at Rs. 10 annually. ... I purchased this estate...from Col. Whish in Decr. 1832. The boundaries were not then well fixed. The drawing given me by Col. W. shows that the high peak of Hatipaon was included in the estate, and also a considerable part of the eastern slope. ... I had the matter settled in Nov. 1833. ...

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[1] James South (1785-1867); Geo. Biddell Airy (1801-92), both astrs. and *DNB.*; Jervis (213). [2] Spencer Joshua Alwyne Compton (1790-1851); PRS. 1838-49; *DNB.*; DDn. 404 (233-5), 28-8-40. [3] DDn.; 406 (157); GBO. Comp. F-17/61. [4] on Simla side of Chaur Peak. [5] DDn. 406 (172-9), 11/22-11-41. [6] (1795-1863), Ben. Engrs.; Hodson, IV (216). [7] Bhadrāj Hill, 7320 ft. some 6 m. beyond The Park. [8] *khud* = hill slope or declivity. [9] Parks, II (231, 275). [10] Wm. Hutton Tweedale (1804-83), Ben. Cav.; sick leave to hills 1832-4; Hodson, IV (334). [11] DDn. Mgte. (3); 19-11-33.

"The rent was increased...to 15 rupees, which latter has been paid up to 12th May 1842. ...

"That portion comprised between the said high road and the panidhar[1] to its north was made over by me to Mr. Peyton, on condition that he made over to me the portion lying between the high road and the panidhar to the south, so that ...the Pioneer, or high, road is the boundary which separates us. Mr. Peyton's estate comprized Clover Lodge, and Kacha Lodge, and is now the property of Major Swetenham. ...

"There are, besides Park House, two bungalows, the one called Bachelors' Hall, and the other called Logarithm Lodge. Many of my sub-assistants have erected temporary dwellings ...in the grounds, but with the understanding that they have no claims to the land on which they stand" [106].

In July 1843 he complained that The Park was no longer attended by the mil. surgeon; "Up to the latter end of 1839 the Medical Officer...was liable...to attend all patients at Hati Paon when required. ... The Doctor's beat extends to Mr. Mackinnon's school which is within ½ a mile of the entrance to my estate [106 n.5][2]. ...

"During the absence of memorialist on the field duties of his profession, ... The Park was...placed beyond the Doctor's beat. ... As he is about to quit India, ...and to leave his estate under charge of an agent to be let, the probability of meeting with a suitable tenant is greatly diminished. ...

"Your memorialist's estate is one of the most valuable in this part of the sub-himalayan range. It is eminently suited to the...accommodation of families, ... but it will...form a serious objection where ladies, children, and invalids are concerned, that it is without the doctor's beat, and that... the public medical officer is at liberty to stipulate for such fees as he may deem adequate [432]. ...

"When The Park was first built...access to it was by exceedingly difficult and dangerous paths, since which period not only has a safe and broad high road been cut by the Pioneers, which is maintained in annual repair at the public expense up to the entrance to the estate, but from that entrance beautiful roads with equable slopes, traced and cut on the most approved scientific principles, have been made by memorialist at his private cost [104, 430][3]".

He arranged to sell his house in Dehra, as well as The Park. The Mussoorie "property itself is very valuable, but no person has yet come forward to purchase, and I think it is better to leave it, and take the chance of getting a fair percentage by the rent, than dispose of it at half price".

Col. Robt. Thatcher[4] bought it through Everest's agent[5] in 1863, and after his rett. to England it was bought by the Skinner family who found it too remote and never lived there. It was then bought by John Mackinnon who d. in 1870, leaving it to his sons the brewers [163 n.8, 166].

The official regrs. of 1843 show properties and houses in the neighbourhood of The Park[6].

Col. Everest; — Park House, built 1829; assessed annual rent Rs. 1,600 — Bachelors' Hall, 1833, Rs. 300 — Logarithm Lodge, 1835, Rs. 600.

Maj. Swetenham; — Cloud End, 1838, Rs. 1,000 — Clover Lodge, built by J. Peyton 1833, Rs. 700 — Hawthornden, by C. Murphy, 1835.

W. Fraser, presumably the Resdt. at Delhi [II, 398 : IV, 32 n.2]:—Leopard Lodge, Rs. 600.

Of these, Park Ho., Cloud End, both substantial residences, and Leopard Lodge, were still habitable in 1951, the remainder being in ruins. The obsy. built in 1839 stands about 100 yds. w. of Park Ho. Logarithm Lodge was pr. the building in delightful position overlooking Dūn, about 500 yds. to w. having 4 rooms with corner fireplaces grouped into central chimney, and a detached cookhouse[7]. Bachelors' Hall was not identified in 1955.

The Park was then still a pleasant estate, wooded except for the w. end, where the Mackinnon family laid out a 9-hole golf-course, No. 5 hole falling near Logarithm Lodge [166].

In 1843 Everest had to put his private affairs in readiness for his departure. Morrison had written to him in 1833; "I heard of Macintosh & Co.'s failure long before you mentioned it, but felt reluctant to communicate it to you. Bad news somehow travels with wonderful speed; I doubt whether intelligence of a prize in the Lottery would reach one as soon [III, 13]. It was well that you got from M. & Co., the amount you did previous to leaving Calcutta. The total sum sent to them by me on your account was Rs. 12,500. I shall be a sufferer by this failure also[8]".

Everest writes to De Penning 8 years later, asking that his deposit with the Union Bank should be at 3 months call; "As to the Government 5 per cent loan, I think...it will not fill. Natives hereabout talk of 8 and even 12 per cent paper. I do not see that the E.I. Company can hope to get parties to subscribe to the amount they...stand in need of. ... The Kabul campaign has absorbed, and is likely to absorb, all their revenues, and to be an unending affair, for the wild tribes are just as far from being subdued as ever[9]".

Leaving Mussoorie 16-9-43, he travelled down the Ganges with Waugh and hdqrs. staff in boats that were none too comfortable [174]. Reaching Calcutta 20th Nov., he handed over to Waugh, and sailed from the Sandheads 16th Dec. in *Bentinck* [320, 367].

He had devoted the greater part of these 13 years to the GTS., which was carried out on the grand scale as he alone could have devised and accomplished. His apparent lack of sympathy for topo. and geogl. svys. and maps was a matter of fixed policy that was often criticised by the uninitiated, and his long absence from Govt. hdqrs. was at times officially resented [207, 318].

Henry Lawrence who enjoyed writing for the Press [453] felt entitled to comment: "Measuring an arc of the meridian is an achievement...which people in general cannot be expected to appreciate, aware as they are only of the vast expense, and seeing no tangible results in the shape of maps. In this stupendous work the Surveyor General has surpassed the European astronomers, and the result is of vast moment to abstract science; but unless his arc is used as the backbone of a web of triangles to be thrown across the continent of India, it is of little practical value.

"Independent as he seems of all local authority, and unshackled as to his expenses, had he been as anxious to supply a general and accurate map of the country as to astonish the savans of Europe with a measurement exceeding all others, as much in accuracy as length, he might have combined...the Revenue and Trigonometrical operations, and furnished a map of India as correct as there is of any part of the world.

"The Superintendent of the Survey is undoubtedly an able man, as well as a first-rate mathematician; but, forget-

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[1] watershed.

[2] School moved by Maddock *c.* 1850 to site of present Savoy Hotel; sold to Diocesan Bd. 1865, and maintained by Stokes, 1867–97; Rambler (58); Stokes' sch. Regr.; *Indian Arch.* [IX/2, 1955 (101–12)].

[3] DDn. 453 (67–70), 26–7–43; these graded paths can still be followed, 1956. DDn. 254, 25–1–33.

[4] (1812–99), Ben. Inf. 1829–61; Stud Dept. from 1850, property in Dūn and Mussoorie; g. son and g. dau. living Mussoorie 1957.

[5] Capt. Murray.

[6] DDn. Mgte. files 15, 37, 117–8. of. map, MRIO. 185 (11–2); 20 in. to m.

[7] Park Ho. has two large rooms, one 36 ft. by 18, facing N. with smaller rooms behind; built on edge of crest overlooking the Dūn, 4,000 feet below to S.

[8] DDn. 284, 15–2–33.

[9] DDn. 413 (76–9), 25–5–41.

ting that real talent shows most in simplification, in applying the depths of science to life's ordinary purposes, he undervalues every thing that is not abstruse[1]".

Everest was indeed single-minded in his great purpose, and, writes Markham, "completed one of the most stupendous works in the whole history of science. No scientific man ever had a grander monument to his memory than the Great Meridional Arc of India. Everest's was a creative genius. The whole conception of the survey as it now exists was the creation of his brain[2]". The EIC. trusted their surveys and maps to the longsighted judgement of Lambton, Blacker, and Everest, and they were indeed fortunate to find in Everest a man of such genius, courage, and determination [vii–viii, 11, 22, 43–4].

The grant of his name to the highest mountain in the world at Waugh's suggestion has been frequently challenged, and as often strenuously defended and, writes his son, "I was so much impressed with Sir Sidney Burrard's able defence...in his article in *Nature* of November 10th 1904, that I gave to him some years ago the gold chronometer that had been presented to my father by the East India Company [III, 446; IV, 130], ... and this chronometer was... presented by Sir Sidney Burrard, with my full concurrence, to the Royal Artillery Institute at Woolwich[3]".

LFE. further calls attention to *S I. Prof. 26*, of 1931[4] and to a letter in *Standard* of 24–1–1905 from Sir Thos. Holdich which concludes: "It was not Everest but his officers who placed his name just a little nearer the stars than that of any other lover of the eternal glory of the mountains. There let it stay, in witness to the faithful work, not of one man, but of scores of men".

On return to England 1844, Everest lived first in Leics. not far from Lutterworth, where he had a country house, became a "bold rider to hounds", and started his 2nd. Gt. Arc book with the help of a clerk on £120 pa.[5] This was pub. in London, 1847, with plates in a 2nd vol., "by order of the Court of Directors". It was a summary of the MS. prof. reports which he had compiled in India, supplemented from private notes [113].

Amongst other pubns[6]. was an elementary paper, "*On Instruments and Observations for Longitude for Travellers on Land*, pub. 1859, *v. JRGS.*, xxx (clxx). He asked Waugh to try his method in India: "Admiral Smyth is the only staunch supporter my plan has[7]. ... A few observations... will be of essential use. I want you to select a good day of 1860, ... when the moon is between two stars, and let us know what degree of accuracy you can arrive at. ...

"I have no instruments; nobody to assist me; my sight is not so good as erst, and I am so out of practice that I can do nothing to substantiate my doctrine. ... Perhaps I am giving you too much trouble, and God knows you have enough on hand"[8].

July to Nov. 1845, visited America "for the benefit of his health", completing the great book on his return, and moving to Lowell Hill, nr. Ascot. At the time of his marriage, 1846, or soon after, he bought long lease of 10 Westbourne St., Hyde Park, where he died. He belonged to the Athenæum and U.S. Clubs.

He continued to take part in prof. discussions, and on his advice in 1861 all Lambton's trgn. in S. India was superseded by new work [II, 256–7].

In a letter written to James Walker, 15–3–65, he discusses the value of an "elliptical compass", and drops into memories of his life in India," I left in India in 1843 for the use of the Department two instruments which I very much miss now. They were my personal property, and...some person may have appropriated them. I do not think I ever made them a present to anyone in particular.

"They were an elliptic compass in a box about 10 or 11 inches long, 4 broad, and 3 or 4 high. A Dynameter in a little box about 4 inches square base, and 3 inches high. If these should ever turn up...I should like to have them. ... I bought them in England in 1829.

"If old Mir Sahib were alive he would point them out; ... Jowahir if he is still in existence [104–5], or Mr. Webb, or Willie Scott, might do the same, and chief of all, my pupil and friend, Radanath Sikdar. Tell them all that though I am now far away, and never likely to see them again, I look back on them with sincere affection and gratitude for the fidelity with which they served under me.

"Dear old *patale*[9], nice, simple-hearted, truthful, and trustworthy *patale*. I often think of them with fond regard, for though I am very happy, and have all that men can desire in this world, I can never forget that I have passed many happy days at Hati Paon, and that they have done much to render them so.

"You are kind enough to offer to execute any commission for me in the way of Puttoo[10]. ... I wear this sort of material in preference to any English manufacture, and Mr. Webb, aided by Robert Scott, has hitherto been most kind in getting me supplied. ... My last supply has worn well, and has lasted through this detestable winter, but I am sorry to say it begins to get very seedy.

"The last supply was exactly the thing I required; ... two thans[11], one of dark brown which sufficed to make two coats, and one of a lighter brown, sufficient to make two pairs of trousers and two waistcoats. ...

"I saw Strange at the soirée of the Royal Society on Saturday last. He was very busy displaying the merits of some instrument which was to be sent out to you. ... Remember me most kindly to all my friends"[12].

LFE. records that his father frequently attended the Friday evening lectures at the Royal Institution in Albemarle St., being well acquainted with Professor Faraday, and a great personal friend of Professor John Tyndall, whom I have often seen at my father's house. He was also a friend of...Dr. Whewell, Master of Trinity College, Cambridge [110 n.5], and Professor Babbage, whose calculating machine my father once took me to his house to see.

"He was also well acquainted with Dr. Livingstone. ... In my father's study...there was a portrait on the wall of Dr. Livingstone, and also...of a river steamer[13]. ... I remember being told...that Dr. Livingstone had dined at my father's house after he had been wounded by the lion[14], and that Dr. Livingstone had difficulty in using his left hand at the dinner table. ...

"Another of my father's friends was the late Sir John Lawrence, ... formerly Governor General of India, and both my sisters, Winifred and Ethel, were presented at Court by...Lord Lawrence's wife. When I was a boy, ... between 1861 and 1866, I remember seeing Lord Lawrence and my father sitting under a tree talking...over old times in India.

"My father was also a friend of a Colonel Feilding [III, 447], a cousin of a former Earl of Denbigh. Colonel Feilding was one of my godfathers, and I received my second name, Feilding, after him. One of my father's intimate friends was a Mr. Pilleau, a well-known artist in his day[15].

[1] Edwardes (119–20) *c.*, 1837.

[2] Markham (94).

[3] LFE.

[4] *Mount Everest and its Tibetan Names.* Burrard; cf. *SI. Tech.* 4; *Mt. Everest its Name & Height*, B. L. Gulatee, 1950.

[5] CM. 2–7–45 (317).

[6] full list, Markham (94–5).

[7] Wm. Henry Smyth (1788–1865); RN. 1805; FRGS. 1830; VPRS.; *DNB.*

[8] DDn. 32 (173–80), 7–11–59.

[9] word not identified, but obviously meaning to GK. "men of the country".

[10] Kashmir woollen cloth.

[11] woven lengths.

[12] Eur Letters, I.

[13] probably the *Mac Robert* of Zambezi expn.

[14] *Mssny. Travel, SA.* (12–3).

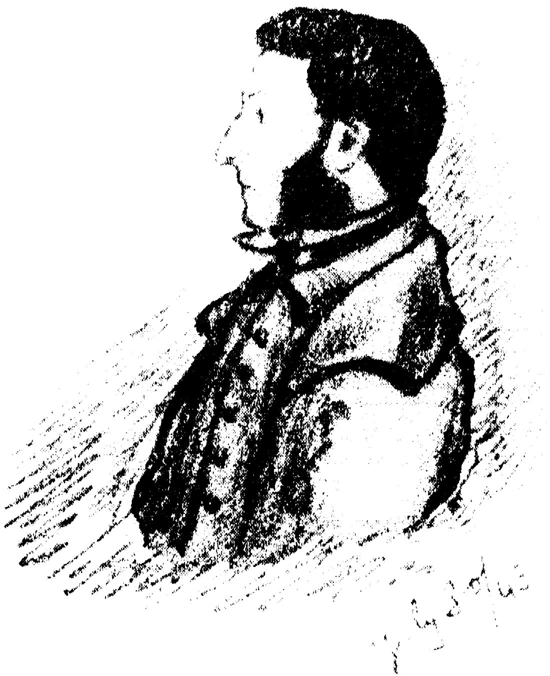
[15] Henry Pilleau (1815–99) landscape painter, RI.; exbts. RA. and RI., 1850–80; travelled Egypt and India.

"My father had two sons by his marriage, and four daughters". Only two of these married, a dau. who left no children, and Lancelot, LFE., who m. a g.dau. of John Bontein [423] in 1886, and "had two children only, both of them sons who...died unmarried. The eldest, Cyril Feilding, was killed on active service in the war of 1914–18. The younger son, George Wilfrid, died a year before the war began[1]".

We reproduce two portraits—the later one, full-face, bearded, enlarged from a photograph probably taken about 1860 by a London photographer [pl. 20]. LFE. records that in 1904, he "lent to the authorities at Dehra Dun" a carbon enlargement of this photograph, from which Lady Burrard painted a portrait in colours—The other, in profile, with side-whiskers, reduced "from a crayon sketch taken July 30th 1843, before his retirement, by a British officer of the army, ... a mutual friend of my father, of the late Lord Lawrence, ... and of the late Colonel Bontein.

"It passed into the possession of Colonel Bontein, ... and afterwards...of his son Mr. John Sims Bontein (formerly an officer in the Royal Marines), whose only daughter I married. It was...handed over to me upwards of forty years ago. ... I presented it to the National Portrait Gallery in July 1932".

Of this crayon sketch, Mrs. Lancelot Everest writes, 21–5–1935, "It is, of course, quite unlike any of the later portraits, but the profile so very much resembles my husband's that I cannot help thinking it must have been a good likeness at the time it was taken". It is reproduced here from NPG. Exbt. 2553 by permission of the Trustees of the National Portrait Gallery.



Geo Everest Lt Col
Survr Genl of India

LFE. concludes his memo. "with a few personal reminiscences of my father. He died when I was thirteen years old, but I was a good deal with him during my early boyhood, and passed many hours seated on a high stool at a deal table studying elementary arithmetic, algebra, geometry, and trigonometry, and learning something about logarithms... from Hutton's *Logarithms*, and my father's tuition. ... But my father's mathematical ability and genius had evidently not descended to me.

"My father was interested in turning and the turning lathe, and under his direction I was given several lessons in turning at Messrs. Holtzafels, who then carried on business in Trafalgar Square. ...

"We used generally, in my father's lifetime, to take our holidays either at Tunbridge Wells or at Brighton[2]. At the latter place he gave me riding lessons, and several times accompanied myself and the riding master in rides on the downs. He was a very moderate smoker, but a copious snuff-taker. In the last few years of his life he used to suffer from periodical attacks of the gout.

"My father was a firm believer in God, as every Freemason ought to be. He attended regularly the Sunday morning services at St. James's Church, Paddington, in the time of the Revd. Dr. Boyd, who was afterwards Dean of Exeter[3], and in my early boyhood we always had family prayers in the morning before breakfast, at which the servants attended, in the good old Victorian fashion[4]".

Everest had claimed the Duke of Sussex' special attention because "I am a brother Mason, one of your Royal brother's Lodge, 'The Prince of Wales' Chapter[5]".

After LFE.'s death in 1935, his widow presented to the writer—

(*a*) Sir Geo. Everest's personal copy of his *Letters to the Duke of Sussex*, with which is bound Jervis' printed pamphlet. It contains Everest's autograph, and numerous pencil annotations, and is now in the Survey library at Dehra Dūn[6].

(*b*) An oil painting, pr. by Peyton [400], looking sw. over the Dūn, taken from Vincent's Hill, Mussoorie, and shewing the obsy. built in 1839. This picture hung in Sir George's study in London and now hangs in the museum at Dehra Dūn.

(*c*) Everest's gold seal, worn on his watch chain throughout his life.

Robert, 3rd son of Tristram Everest, was b. 19–1–1798, at Greenwich; ed. Oxon.; MA.; ordained and appd. chpn. EIC. 1–4–29.

arrd. India Jan. 1830.

Studied geology at Oxon., and elected member of Geol. Soc.; submitted to RS., 1829, a geol. paper entitled "A Journey through Norway, Lapland, and part of Sweden"[7].

1831, recorded geol. obsns. between Calcutta and Ghāzipur, where he maintained metl. records April 1831 to Jan. 1833.

Feb. to April 1833, accd. SG. and Wilcox from Mirzāpur through Saugor, Gwalior, and Agra, to become chpn. at Delhi [152]; asstd. by burning blue lights in Delhi, Feb. 1834 [33]; stayed at The Park in 1835 [434–5].

Furl. from 25–6–41; on return 1844, posted to Nimach; ret. 17–12–48.

After rett. entertained nephews and nieces at 53 Cleveland Sq. London, and then at Ascot, where he d., unm., 1870[8].

Member of Reform Club, and admirer of John Bright[9].

Papers on geol. and metl., *JASB.* I, 1832 (450–4); III, 1834 (18–24, 345–9, 631–6); IV, 1835 (207–11, 690–4); V, 1836 (281–7); VI, 1837 (108); VII, 1838 (192–6); VIII, 1839 (313–6); which include essay on "*Revolution of*

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[1] LFE. (10–3). [2] This may explain burial at Hove [433 n.4]. [3] Archibald Boyd (1803–83), *DNB*. [4] LFE. (26, 28). [5] Everest (4). [6] GBO. Lib. Q. 66. [7] *Phil. Trans.*, 1830, appx. 6. [8] in *Army List* 1870; omitted 1871. [9] LFE. (3–4).

the Seasons", and "*Rainfall in India 1831–8*". Regular copies of metl. obsns. taken at SGO. Calcutta were sent to him at Delhi from May 1833 [119–20];

Paper on "*The Sandstones of India*" discussing James Franklin's work in Bundelkhand [III, 448–9] was pub. in *Gleanings in Science*, III (129, 207)[1].

FERGUSSON, Josias Du Pré. Ben. Inf.
b. 1915. d. Sabāthu, 27–12–44, aged 29.

Ens. 19–7–30 ; Lieut. 8–1–39.

Son of Benjamin Fergusson, mariner [207 n.3], and Eleanor his wife. Hodson, II (175) *Punjab Inscpns.* (106).

6–12–38, appd. Asst. Rev. Survr., Cawnpore under Saunders Abbott.; frequent autogs. and initials on village plans, Akbarpur, Cawnpore, 1839 ; MRIO. Rev. Svy. Oct. 1839, tr. to Maxwell's svy. of Ghäzipur[2] [308].

Oct. 1840, reverted to mil. duty.

FITZPATRICK, John [III, 371],
Rev. Survr., Bengal ; uncov.
b. Jan. 1806.

Appce. survr. 2–10–21 ; Asst. Rev. Survr., 1833 ; ch. Balasore svy. Feb. 1838 ; Rev. Survr. 30–3–41 ; resd. 1845.

son of Robt. Fitzpatrick, Dep. Commy. ; bro. to Arthur, b. 1–10–02 [III, 22, 371].

m., Fatehgarh, 26–5–34, Miss Margaret Isabella Macklin, who d. Balasore, 2–2–39, aged 22 y.

ed. Upper Mil. Orphan Sch. Kidderpore [III. 360, n.4]; remaining at sch. till posted, June 1823, to Sahaswān rev. svy. under Bedford, later holding ch. of detachments, Rs. 200 pm. ; reported 1831 as "quick and intelligent", and 1832, "since...March 1831...has performed all the duties of an Assistant Surveyor. His behaviour generally has been correct and orderly, and his character most respectable. During the 8 years he has served under me I do not remember to have received a single complaint against him"[3] [387–8].

Oct. 1833, with Lawrence to Farrukhābād, and then to Bānda, 250 pm. ; Aug. 1837 to Lawrence at Allahābād ; Feb. 1838, to ch. Balasore svy., Rs. 350 pm. ; "capable and efficient". Promoted Rev. Survr. Rs. 526 pm. under BRC. 30–3–41 [178, 186–8, 190–1, 365, 392–3, 395–6].

Oct. 1842, on break-up of Balasore svy., to ch. in Purnea & Rājmahāl ; "found mass of arrears accumulated under Captain Ellis and Messrs. Shaw and O'Donel. Had to reject very nearly half the *amin's* papers, which work had to be revised at the close of season 1843–4, and by the end of 1844 had completed and submitted all arrears[4] [184, 306]".

1845, relieved of ch. of Purnea svy. for unsatisfactory progress and intemperate letters to DSG. ; complained that Govt. allowed him no opportunity to state defence ; resd. when tr. to Sherwill's party.

FORDYCE, John. Ben. Art.
b. 4–3–06. d. 26–2–77.

2/Lt. 10–5–22 ... Lt.-Gen. 21–1–72 ;
Col. Comdt. 5–4–73.

Son of James D. Fordyce, clerk to Messrs. Reid, Irving & Co., of London, and Margaret his wife, dau. of James McDougal.

m., 1st, 1830, Mrs. Bennett, who d. at sea, 5–11–30 — 2nd, Paris, 16–3–42, Maria Louisa, dau. of H. G. Alleyne, of Barbados I ; she d., Nasirābād, 2–9–45 — 3rd, Meerut, 14–4–47, Phoebe, dau. of Dr. James Graham.

ed. Addiscombe, 1820–2. KOB. 1873.

DIB. ; *Ubique* ; Hodson, II (204).

Comnd. with Henry Lawrence, and with him to Arakan 1825–6 and 08. in Ireland [III, 68–70 ; IV 452].

4–11–33, appd. Asst. Rev. Survr., Muttra under Wroughton ; March 1834, tr. to Simmonds in w. Azamgarh ; Sept. considered by DSG. too inexperienced to raise new party [214, 224, 362–3, 470].

8–3–35, succ. Simmonds in ch. w. Azamgarh, with actg. allces. only ; on completion of w. Azamgarh, Oct. 1836, moved party into w. Gorakhpur, now Basti Dist. ; 1837, promoted to full survr's. allces. on orders of Rev. Bd. against advice of DSG. who considered his progress slow, and his health poor [215, 225, 465, 470].

Nov. 1838, moved party to Agra ; 25–9–39, leave on mc. to Mussoorie, suffering from "dyspepsia, haemorhoids, and boils" ; leave extended till Nov. 1840 ; furl. 1840–3 [222, 233–4, 308, 457].

Regtl. duty till 1853, when appd. Agent for gun carriages, Fatehgarh. Comdt. Ben. Art. 1850.

FRASER, George John [III, 449]. Ben. Cav.
b. 14–5–1800.
d. Aurangābād, 27–8–42 ; MI.

Corn. 17–7–22 ... Capt. 12–11–38.

Son of Edward Satchwell Fraser of Reelig, co. Inverness, and Jane his wife ; bro. of James [II, 308] and Wm. (1784–1835), BCS., Resdt. Delhi [32 n.2].

m., Delhi, 12–9–32, Wilhelmina, dau. of John Moore of Liverpool.

Hodson, II (217) ; Crofton, II (113).

from 1827, Asst. Rev. Survr., Sahāranpur, holding ch. of detts. under Wm. Brown in Muzaffarnagar, etc. [III, 157, 165 ; IV, 211, 219, 353, 362, 387 ; pl. 13].

Aug. 1832, to ch. Sahaswān svy. *vice* Bedford, with hdqrs. at Bareilly till Feb. 1836, when appd. Asst. to Resdt. at Nāgpur [148, 214–5, 221, 368, 416, 463–4].

MRIO. 72 (68), survd. routes Nāgpur to Raipur, May 1838.

FRASER, John Wedderburne. Ben. Engrs.
b. 4–10–10. d. unm., London, 2–4–42.

Lieut. 28–9–27.

Son of Hugh Fraser of Phopachy and Torbeck, and Elizabeth Dunbar his wife.

ed. Addiscombe 1826–7. Conolly (87/148) ; Hodson, II (210).

1834–6 : Ex. Engr. Balasore ; 1836–8, Cuttack [457].

12–9–37, appd. to ch. of rev. svys. in Orissa, 23–3–38 ; before work fully started, granted leave to sea on mc., to regret of Comnr. who describes him as "able, zealous, and industrious, ... particularly fitted for the arduous task entrusted to him[5]" [186, 208, 347, 364–5, 368].

GAISFORD, Thomas. Bo. Art.
b. 14–6–10. d. 26–9–1900.

2/Lt. 12–6–28 ... Capt. 12–6–43 : ret. 1852.

Son of William and Caroline Gaisford, of Bagstone, Glos.

m., 1st, Ahmednagar, 12–7–48, Emily, dau. of Capt. Geo. Birch, RA. ; she d., Ahmednagar, 4–10–51.

m., 2nd, in England, 10–10–54, Catharine, dau. of Robt. Martin.

Spring (91/314). Intpr. Hindi and Marāthi.

30–12–28, arrd. Bombay ; 5–12–37, appd. Asst. Rev. Survr., Deccan, [236, 366] ; devised sun-hat for Davidson [429]. c. Oct. 1840 to mil. service with unit [367, 369].

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[1] Everest (42–3) ; Markham (208–277).
[2] NWP. Rev. 4–10–39 (6, 7).
[3] from Bedford, 12–8–32 ; BTO. 2–9–33 (14).
[4] from Fitzpatrick, 26–7–45 ; BRC., 4–6–45 (6–8) : 13–8–45 (31–2).
[5] BRC. 12–6–38 (85).

GERARD, James Gilbert [III, 452–3]. Ben. Med.
b. 13–2–1793. d. unm., Sabāthu,
31–3–35 ; MI. Simla cart-rd. cem.

Asst. Surg. 27–11–14 ; Surg. 5–5–26.

Son of Gilbert Gerard, DD., of King's Coll. Aberdeen, and Helen his wife, dau. of John Duncan, provost of Aberdeen ; bro. of Alexander and Patrick, both Ben. Inf. [III, 451–3].

MRCS. 1814.

DNB. ; *DIB.* ; Crawford, II (141) ; Crawford's *Roll* 67, B 738) ; Lloyd, I (283–6 ; *Punjab Inscpns.* (124).

1818, accd. his bro. Alex. on several expns. to Upper Sutlej, making further expns. of his own, including one undated to Spiti, described *As R.* XVII, 1833 (238–78) ; paper on *A Method of rectifying a Route Protraction*, dated Calcutta, 28–11–31, *JASB.*, I (19–20, 40 n.5).

1815–34, MO. 1st Nasri Batt. at Sabāthu and Kotgarh, to which his bro. Patrick belonged [III, 30 n.7].

Dec. 1831, in poor health, joined Burnes for hazardous expn. through Lahore, Peshāwar, and Kābul to Bukhāra, which they reached 27–6–32. Frequent attacks of fever [VII, 10, 274–6, 424–6].

Burnes narrates that on arrl. Kābul "we proceeded straight to the house of...the brother of the Governor, who gave us a cordial welcome and...a dinner which I enjoyed. Not so my unfortunate companion, whose health forsook him immediately after crossing the Indus. His strength was now completely undermined".

At the customs inspection "my sextant and books, with the doctor's few bottles and boxes, were laid out for the inspection of the citizens. They did them no harm, but set us down without doubt as conjurors"[1].

On return via Meshed in Persia, Burnes left the party 29–9–32, leaving Gerard to return to India with Mohan Lal who has left detailed account of the journey [274, 457]. Spent about 7 mo. in Herāt, and then kept svy. of route via Kandahār and Kābul, reaching Peshāwar, 10–12–33.

Oct. 5th 1832, writes Mohan Lal[2], "we reached the city of Mashad. ... Mr. Shee [420 n.6] asked us to live with him, but Mr. Gerard refused on account of his [Shee] having a family. However, he pitched tents for us, and entertained us in very hospitable manner".

6th. "H. R. H. Abbas Mirza made his entry into Mashad".

7th to 9th. "We went with Capt. Shee to see Yar Muhd. Khan, vazir of Hirat. ... He conversed with Mr. Gerard in a most friendly, cordial, and respectful, manner. ... Wished to be friendly with the British Government. ... The Shah, he said, would be very glad to see us in Hirat...because Mr. Gerard would be a strong medium to effect a friendship between the two Governments"[3].

Nov. 3rd to 10th. "Dr. Macneil[4], the Assistant Envoy to Tehran arrived at Mashad with an embassy to H. R. H. Abbas Mirza. He came to see Dr. Gerard in our house".

29th. "We took happy leave of the holy city of Mashad for Mahmudabad where Dr. Macneil was with H. R. H., and Capt. Shee came a little way with us". Later in the day "Dr. Gerard was sick and tired, and sat on the ground, holding the bridle of his horse, while I began to search for our servants. ... We passed the night very uncomfortably ; slept upon frozen ground". 30th. "We...came back to Mashad, and did not meet any of our servants", who came in later ; "my Indian servant, who was used to a hot climate suffered severely from the snow, so that his feet and hands were motionless, and he had lost his spirit and sense".

Dec. 1st to 4th. "We continued in Mashad on account of Dr. Gerard's illness".

Dec. 5th. "We were happy to leave Mashad, accompanied by a European serjeant in the service of the Honourable Company, and lately in Persia with H. R. H. Abbas Mirza".

8th. "We arrive at Turbat...and were conducted to Dr. Macneil's house". ... 22nd. ; "We left Turbat on our route to Herat". ... 30th. "We arrived at Hirat, where we were welcomed by the Vazir's family".

Between 4th Feb. and 16th March 1833, Mohan Lal revisited Meshed, carrying letters from Gerard to Abbas Mirza. March 20th to 22nd. ; "Sardar Din Muhd...asked Dr. Gerard to write to H. R. H. Abbas Mirza and settle the affair of Hirat. Dr. Gerard, on account of Dr. Macneil's writing, agreed".

June 15th to 30th, Gerard and Mohan Lal had audience of the King at Herāt, who told them "that he would be happy to receive a mission from the English Government, and especially us. He repeatedly said to Mr. Gerard that he hoped to see him here as ambassador in a few months, and desired him to take his letter for the Governor General".

25th July 1833. "We were quite happy to leave Hirat in which we unwillingly remained for seven months".

4th Aug. "We reached Hauz...before daylight. A few camels...had gone a little ahead. As soon as they passed out of the valley they were suddenly attacked by eleven robbers, who took two camels loaded with our things. In one of them were all my papers, journal, and a few English articles. We were one mile behind the robbers. ... I rode up with my musket. ... The robbers thought in the dark that all the footmen were protected by guns. Dr. Gerard, without any instrument, dared often to follow the thieves, but I did not let him go, because we were all unarmed.

"At last the day dawned, and the caravan encamped near Hauz. ... I rode on to Farah, a distance of 30 miles. At evening I was quite delighted at the return of our servants, who brought all my papers and journal. ... The spy-glasses, which were considered to be of gold, were burnt in the fire by the robbers. ... Some papers they washed with water".

23rd. ; "We arrived at Khak Chaupen. ... Dr. Gerard entered the camp very late, as he had missed the road in the night". 25th. ; "Reached Qandahar. Very friendly reception".

Sept. 21st to 29th. ; "Qandahar. We...received a kind letter from Captain Wade [III, 510 ; IV, 281], with a large bundle of newspapers." Oct. 20th. ; "Leave Qandahar".

"Ghaznin. The officers of Ghaznin custom-house came and searched the whole of our baggage. There was nothing... liable to duty. However, over-ruled by avarice, they put taxes on our caps, cloaks, and tea-cups, and asked for 50 rupees, which we were obliged to pay".

Left Ghazni 3rd Nov. and reached Kābul 5th. "At dinner we were delighted to see Mr. Masson, a famous traveller, of whom we heard with great praise from Dr. Macneil at Mashad. ... He is young, wise, and also a good poet as I ever saw [450]".

Nov. 6th to 20th. "Continued at Kabul. Dine with Sardar Dost Mahammad Khan. He asked us to stop with him at Kabul, and show him how to drill and dress soldiers. ... He asked Dr. Gerard when Abbas Mirza—who was a friend of Russia—comes to invade Kabul, what the English Government would do in India [283]. The reply of Dr. Gerard was that he would also tell him when he found an opportunity of seeing the Sardar alone".

21st. "We quitted Kabul".

23rd. "Shaped our route to Jagdalak. ... Ascend a very high pass buried under the snow. The thermometer, when looked at by Dr. Gerard at the end of the pass, was 30 degrees".

They stayed at Peshāwar, with occasional trips out, from 10th Dec. to 7th Jan. ; Jan. 13th, Hasan Abdal. 14th. "Arrived at a small town called Rawal Pindi, famous for brass and copper articles".

18th. "Came to Dah Mak. Saw the camp of General Ventura[5], who accompanied by General Court, came to receive us [428]. At night we had a talkative party of gentlemen, in which Dr. Gerard delighted very much". 19th and 20th. "Invited to dine with General Court. He has also made a fine and very correct map of the Punjab, but says that he is not allowed to visit Kashmir, which he thinks would be an important thing in his map [274, 428].

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[1] *Bokhara*, II (112). [2] Mohan Lal (153–336). [3] Herāt was then completely independent of both Persia & Afghānistān.
[4] Later Sir John McNeill (1795–1883) ; Bo. Med. ; *DNB.* ; Vigne, I (13). [5] *v.* Bullock, *Indian Arch.*, I (18–25), Jan. 1847.

The party reached Lahore, 30–1–34, and found Ranjit Singh sick of dysentery. He would not take Dr. Gerard's prof. advice, for, writes Mohan Lal, "he never trusted any Doctor". They remained at Lahore till 28–2–34.

Further details of the journey, Peshāwar to Bukhāra, will be found in Gerard's letters pub. *JASB.*, II, 1838 (1 22). He had been a sick man when he started, and had to be carried in a *palki* most of the way from Herāt. He died within 12 mo. of his return to Sabāthu.

Map compiled from his notes and bearings by his bro., proved of great value to the Army of the Indus, 1839 [III, 453 ; IV, 276, 278, 294 ; pl. 16].

Colln. of antiquities and curios picked up by Gerard and Burnes reached ASB. at Calcutta[1] [427].

Vigne records that on his journey to Simla, in 1834, he was "welcomed at Sabathu by Dr. Gerard, ... and passed an agreeable evening in the society of himself and his two brothers"[2] [472].

GIBERNE, Henry. Bo. Art.

b. 17–10–10. d. Hackney, England, 1–9–48 ; MI. Christ Ch., Byculla, Bombay.

2/Lt. 9–9–27 ... Capt. 3–7–45 ; furl. 18–7–46.

Son of Mark Giberne, wine merch., and Rebecca Sharpe his wife ; bro. of Charles and Mark, both of Bo. Est. and uncle to Miss Agnes Giberne, dau. of Charles, and a well-known auth., who d. 17–9–1939, aged 94.

"She was descended from an old and noble French family, the de Giberne's, whose home for centuries was the Chateau de Giberain in Languedoc. Her own immediate ancestors settled in England in the eighteenth century, serving the country of their adoption in both Church and State. She was born in India in 1845"[3].

1836–8, comdg. art. with dett. serving under James Outram, PA. in Mahi Kāntha, and emp. on svy. of both Mahi and Rewa Kāntha [19, 241–2, 383, 460].

1843–4, Dep. Commy. of Ordnance.

GOLDSMID, Henry Edward. BO CS.

b. 9–5–12. d. Cairo, 3–1–55 ; MI. Christ ch. Byculla.

arrd. India, 11–5–31, 1832 ; Sec. Rev. Dept. 1848 ; Ch. Sec. 1854.

Son of Edward and Rose Goldsmid, of Upper Harley St. ed. Haileybury. *DNB.*

m., England, 27–11–45, Jesse Sarah, sister of M Gen. Fred. John Goldsmid, Mad. Est. ; KCSI.

1835, appd. asst. to Rev. Commr. at Poona ; 1837, Supt. Rev. Svy. & Assmt., "just the man for such an emergency. ... He had as an assistant Mr. Bartle Frere, a civilian younger than himself, and he found ...an equally young Engineer officer, Lieut. Wingate" [236, 239–40, 475].

Under Goldsmid's direction was founded a "school of revenue officers who gave effect to the ryotwari system of direct tenure of the cultivators from the Government as landlord, the system generally adopted in western India". Davidson worked under him on svy. and settlmt. of Nasik in 1842 ; "I found the Superintendent with his tent pitched in the sun, although there was a splendid tope of trees close at hand ; sitting in his pyjamas and shirt, busy writing in the midst of a lot of Brahmin clerks, using his shirt sleeves for blotting paper, and deeply immersed in his work"[4] [429].

March 1846, on return from furl. took ch. Deccan svy. from Landon at Poona, and in Jan. 1847 relieved Nash as Supt.

GRAHAM, John [III, 371]. Head Dmn.

b. India *c.* 7–12–1801[5].
d. Calcutta, 19–7–58.

Appce. Survr. 1816 ... Hd. Dmn. Aug. 1828 ; ret. Feb. 1858.

Officially recorded as son of Capt. John Graham, the only offr. on Ben. Est. who fits being of Ben. Inf. ; b. 1777 ; arrd. India 1797 ; Lieut. 1800 ; Capt. 1812 ; d. at sea 1816 on voyage to England[6].

John Graham jr. was ed. Ben. Upper Mil. Orphan Sch., Kidderpore.

m., 1st, Meerut, Arabella née Berkeley, wid. of Chas. Smith of Bareilly. Their son Walter Rose Malcolm Graham (1821–60) became asst. in DSG.'s office, Calcutta [350].

m., 2nd, Calcutta, 22–1–39, Caroline, dau. of late Maj. C. J. Ridge (1777–1820), Ben. Cav., Hodson, III (654–5) ; she d., Calcutta, 23–1–44, leaving 2 sons and 2 daus. ; a g. son, Bertram Robt. Graham (1874–1916), ISO. 1894, kd. in action E. Africa, 1916, m. in Australia, 1911, leaving son who was with business firm in Calcutta, 1950.

m., 3rd, Calcutta, 23–12–46, Caroline, eld. dau. of Joshua De Penning [III, 472–3 ; IV, 430].

m., 4th, pr. Calcutta. 5–10–48, Charlotte McLeod.

14–5–16, from Orphan Sch. to rev. svy. Sahāranpur under Gerard [III, 300]—Jan. 1820, with Herbert and then Oliver on topo. svy., Garhwāl and Sirmūr [III, 38 n.2]—1822, sub-asst. survr. with Oliver to rev. svy., Delhi [III, 156 n.2]—Sept. 1827, to SGO. Calcutta, succg. as Hd. Dmn. Aug. 1828 [III, 313 n.7], on *sicca* Rs. 323 pm.—held continuous ch. of drawing office, Calcutta, till rett. 1858 [293, 295, 314].

SG. notes, 8–10–44, that "Mr. Graham is a very able, zealous, and experienced public servant, well acquainted with the records, and fully alive to the honour and credit of the office"[7]. DSG. writes of his services, 24–7–51 : "On the removal of the headquarters from the Presidency in 1832 [335], Mr. Graham...received no acting addition to his salary, or personal allowance for...the duties of the Registrar [Store-keeper]. He has now been 35 years in the Department, and has been on his present salary since the year 1828"[8] [337, 341].

CD. to B. 12–1–53 sanctions increase of salary Rs. 113 p.m.[9]

GRAHAM, William Dashwood. Bo. Engrs.

b. 17–3–13. d. 23–4–60.

2/Lt. 10–12–30 ... Maj. 15–9–57 ; ret. 4–7–58.

Son of Robert Graham, BCS. (1776–1815), and Sarah his wife, dau. of Stephen Paul Monckton.

m., St. James's, Westminster, 19–10–48, Susan, dau. of Lt.-Gen. Sir Thos. Dowman, KCB. (*DNB.*).

Conolly (106/95).

1830, made svys. and maps in Rajpipla and "the strong hill country called the Daung" to the west.

GRANT, Charles Edward. Ben. Inf.

b. 15–5–09. d., Bānda, 22–6–41 ; unm.

Ens. 19–1–28 ; Lieut. 2–8–32.

Son of Alexander William Grant and Mary his wife. Hodson, II (313).

13–11–38, appd. Asst. Rev. Survr. Allahābād ; 1839, to Bundelkhand as asst. to Stephen, till death [368, 392].

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[1] *JASB.* II, 1833 (1–22 ; 143–9) ; III, 1834 (246) ; VIII 1839 (528). [2] Vigne, I (28). [3] *Times*, 22–9–1939. [4] Davidson (184–5, 195). [5] Survey Rolls ; DDn. 464 (8–9), 1–535, age 43 y. 4 mo. 24 d. ; ib. 543 (43), 1–5–50 ; aged 48 y. 4 mo. [6] Hodson, II (303–5). [7] DDn. 414 (41). [8] DSG. to SG., DDn. 553 (5). [9] BMO., 15–4–53, DDn. 580 (71) ; SG.'s, 13–8–52, DDn. 542 (324).

GRANT, Charles William. Bo. Engrs.
b. 25–8–04. d. 1–12–89.
Ens. 19–6–20 ... Lt Col. 16–8–43;
Col. 28–11–45; ret. 2–7–53.

Son of George Grant, banker of Portsmouth and Elizabath his wife.

Conolly (105/64).

MRIO. 118 (2), as Ex. Engr., survd. road Belgaum to Vengurla, sd. 11–12–35.

GRIFFITH, William. Mad. Med.
b. 4–3–10. d. Malacca, 9–2–45;
MI. Bot. Gdns. Sibpur.
Asst. Surg. 24–9–32.

Son of Thomas Griffith, of Kingston-on-Thames, Surrey.

ed. London Univ.; FRGS.; FLS.; distinguished botanist.

m., Calcutta, Sept. 1844, dau. of James Henderson, 11th Lt. Dragoons, and sister of wife of his bro., Capt. Henry Griffith (1807–52), Mad. Inf.

DIB.; Griffith, being *Posthumous Papers & Journals*, with bio. note and portrait, ed. by McClelland, 1847; *JASB.*, x, 1841 (797–815, 977–1037); xi, 1842 (49–90); xxiii, 1855 (623–48); Burkill (58–71).

Arrd. Madras 24–9–32; posted to Mergui.

1835, with Wallich, botanist, and McClelland, geolgt. and soil expert, to Assam, to report on "tea-forests" [204][1].

Oct.–Nov. 1835, crossed Khāsi Hills, Cherra to Gauhāti, to Upper Assam. 15–1–36, "we arrived at Kujoo, a rather large village of Singfos[2], and within half a day's journey of which the tea is found in its native state".

Oct. 1836, visit Brahmakund and Mishmi country; on return, Dec., "reached the Muttack Panee, ... ascended the dry bed of the Muttack [204–5]. ... Dec. 11th. Visited the tea at Nigroo. ... 18th. The Major. arrived (probably Major R. Bruce of the Rajah's service, one of the Superintendents of Tea Cultivation)"[3]. Account of this tour, *JASB.*, vi, 1837.

Feb. to June, 1837, with Simon Hannay from Sadiya over Patkai Range, by route s. of that followed by Wilcox and Burlton ten years earlier [iii, 59–62]. Met Bayfield and travelled with him down Hukhawng valley to Mogaung, and reached Ava, 15–5–37; noticed specimens of tea plant *en route*[4] [419]. Griffith counted 28 stages Sadiya to Mogaung, totalling 378 m., and allowed 12 days for river journey down to Ava, about 285 m.

Left Ava 28th May, down Irrawaddy to Rangoon, and thence to Calcutta.

31–8–57, left Calcutta with orders to join Pemberton's mission to Bhutān. Travelled via Dacca, and by river to Sylhet, reaching Cherrapunji 25th Sept. [263–4, 421]:

> "16th Oct. ascended the Chilong [Shillong] Hill, which is among the highest portion of this range[5]. ... The summit is gained after an easy march of two hours; the ascent is gradual, The highest ridge is naked of trees, but to the north the slope is in one portion covered with heavy tree jungle. ... The forest itself of oaks, chestnuts, and rhododendron. ... A few pines occur. ... To the north very high ground is visible, as likewise from Myrung, and between this and Chillung is an elevated plateau which appears to me likewise very eligible for the sites of European residences. ... It is much to be regretted that some situation in this part of the range had not been selected for the site of a sanatorium instead of Cherra"[6].

From Gauhāti reached Dewāngiri, 3–1–38; met Pemberton, and commenced march through Bhutān. Blake kept the svy. whilst Griffith made obsns. for height by Woollaston water-boiling apparatus [iii, 222]. Journal tells mostly of botany, with occasional notes about people. "Renka. ... Audience with Rajah. ... Priests...are great beggars, and the headman was well pleased with a present of four rupees. He gave—Pemberton two, Blake and myself one each—papers of salt, similar to those given to the lookers-on".

> 15th Feb., another account of the crossing of the "Domyla" [204]; "Coolies. ... all off by 6½ a.m, ... had halted, refusing to go on as it was already dusk. Learning that Pemberton and B. had gone on, I hurried on likewise...until it was quite dark, ... and...determined on returning. I reached the coolies about eight, covered with mud, the path in the wood being very difficult and excessively slippery. I had nothing but broken crusts to eat; I procured some sherry, however, and my bedding being up I was glad to take shelter for the night under the trees.
>
> "Next morning, on overtaking P. and B., I found that they had remained all night in the wood without anything to eat, and without bedding. ... We reached the village about 9½ on the 16th fatigued and dispirited. Nothing was at hand, and we had no meal until 5 p.m., except some tea and an egg or two"[7].

Crossing the pass of Bodoola 26–2–38—12,935 feet—the party reached Punaka 1st April; "we were all dreadfully disappointed in the capital". ... 9th. "Audience with Deb—the whole business went off very well. ... We left Punakha 9th May. ... 18th ... Buxa".

Griffith (303–12) gives daily stages with records of thermometer, and heights.

Griffith (313–519), Afghānistān journal; 10–12–38, "reached Loodianah...after a dawk journey of fourteen and a half days" from Calcutta. "Loodianah is situated about five miles south of the Sutledge, in the midst of a sandy country. ... The fort and Capt. Wade's house are...on a rising ground" [424].

Travelled down Sutlej by boat, in company with Macnaghten, Envoy to Kabul [281]. 10–2–39; "Mamdot. ... Tassin's map [293, 312] of but little use as few of the names are recognized by the boatmen or villagers. ... Khan of Mamdot visits Envoy".

27th, "We came on the Indus early in the morning, and stopped opposite Mittunkote until 2 p.m. awaiting the arrival of Mr. Mackeson[8] [292 n.6, 472].

25th March, reach Quetta. ... 27th April, Kandahār, with Army of Indus, which he had joined at Shikārpur. Asstd. with barometer obsns. for height and astr. obsns. for position [282, 294].

Journal, though mostly devoted to botany, refers to events on march—assault of Ghazni, and blowing up of fort gate by Peat and Durand. Interesting trips from Kābul, including Bamiān [279, 282–4]. Left Kābul 7–10–39, arrg. Peshāwar 7–11–39.

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[1] Griffith (1–59). [2] Kachins of Upper Assam [iii, 54 n.2]. [3] Robt. Bruce, d. 1840, [204 n.4]; another Supt. was Chas. Alex. Bruce, his yr. bro.; Burkill (56–7). [4] Griffith (152–312). [5] The Peak, Shillong, 6,441 ft. [6] station of Shillong founded as hdqrs. K. & J. Hills, 1864, of Assam, 1874. [7] Griffith (244); *Hill Tracts*, Calcutta, 1873. [8] Agent, Indus Nvgn., 1835–7.

Extracts from letters, Griffith (xiii–xxix): Peshāwar, 17–11–39; "I hope some day to turn out a real traveller. I am now in hopes of becoming a decent surveyor, and before many years...a decent meteorologist. I leave the Army here, and shall part with it, particularly Thompson and Durand of the Engineers, with regret. ... I am doing nothing in botany, but learning Persian and the use of the theodolite".

Accd. mil. expn. from Jalalābād into Kunār and writes, 29–1–40; "My employment is surveying and collecting data for ascertaining the heights of the hills around[1]. ... Early in July I proceeded to Cabul for change of air, and as soon as I recovered a little strength, started to join Lieut. Sturt [283 n.6, 468], who was surveying on the Toorkistan frontier".

He describes contacts in Afghānistān with Burnes, Conolly, Lord, Edward Sanders, and others [404 n.5, 468].

On withdrawal from Afghānistān, visited Narbada R. and Simla, reached Calcutta Aug. 1841, and was posted to Malacca. Recalled to Calcutta, Aug. 1842, to act for Wallich in ch. Bot. Gdns. Sibpur, till late in 1844. d. shortly after return to Malacca[2].

Griffith (517–9) gives table of lats. and heights obsd. in Afghānistan 1838–40. "The altitudes for the latitudes were taken with the sextant and the artificial horizon, and the results throughout are so nearly coincident that [they]...may be relied on to within half a minute". Of the 99 places in this table, Kandahār had 60 obsns.—Cābul, visited twice, 42—Jalalābād, 24 obsns.[3] [282, 294].

Reporting on his Peshāwar svy. of 1849–53 James Walker writes highly of the value of Griffith's obsns. and journal; "Its geographical information appears to possess accuracy superior to that of any other work extent on Afghanistan. In every instance in which a comparison could be effected, its deductions, though obtained with inferior instruments, and under manifold disadvantages during the course of a rapid march, were found to differ very slightly from the results of this survey.

"The barometeric heights given by the Doctor are especially good. For instance, he makes Peshawar 1,070 above the sea level, or 100 feet less than the G.T.S. value, whereas all other travellers have made it from 600 to 1,000 feet in excess"[4].

HAINES, Edward. Ben. Engrs.
bapt. 30–6–20. d., Moulmein, 5–11–49.
2/Lt. 10–12–39; Lieut. 12–2–44.

Son of John Haines, surg., and Jane his wife, of Hampstead.

ed. Addiscombe. Conolly (89/203).

27–10–41, appd. asst., PWD., SE. Provs.; 1845, Supt. Raipur mail road; MRIO. 63 (25–6), svy. of roads Chota Nāgpur to Nāgpur [269].

HANNAY, Simon Fraser. Ben. Inf.
b. 12–11–01. d., Dibrugarh, 25–1–61.
Ens. 3–4–20 ... Bt. Col. 20–6–57.

Son of Henry Hannay, or Hannah, of Elgin, Collr. of Excise, and his wife, dau. of Capt. Simon Fraser of Daltulic, co. Inverness.

m., 1st, Calcutta, 4–7–27, Margaret Campbell, dau. of Alex. Graham of Glasgow; she d., Gauhāti, 4–7–41.

m., 2nd, Calcutta, Mary Florence, dau. of Alex. Campbell.

Hodson, II (381–2), sv. Hannah, explains that he is thus named in IO. Rec. and *EIR.*; though shown as Hannay on his own grave and that of his 1st wife. Always Hannay in Survey records, *JASB.*, and Griffith.

With mission to Assam, 1835–6; route svys. in Upper Burma 1836–7, one being from Sadiya to Ava over Patkai Range with Griffith [205, 419, 446].

JASB., V, 1836 (126); Burney sends from Ava buddhist images found by Hannay who had reached Mogoung, 5–1–36. ib. VII, 1838 (368, 625–8), papers on gold-washings, Upper Assam; (671–9), paper on "Moa Morah sect" [I: 81, 399; III, V, 57 n.3; IV, 294 n.2].

2nd-in-comd. Assam LI. 14–5–38; Comdt. 1st Assam LI., 25–3–39, till death.

HERVEY, Gerald Augustus Frederick. Ben. Inf.
b. 9–6–16. d. 2–5–91.
Ens. 12–12–34 ... Capt. 12–10–45; inv. 7–1–53; ret. 10–12–61.

Son of Hervey Augustus Hervey [III, 458], Bo. Inf., and Margaretta Adriana Giester his wife.

Hodson, II (437).

Nov.–Dec. 1840, with Rāmgarh LI., survd. Doranda cant., nr. Rānchi [209].

HILL, Charles Thorold [III, 458]. Mad. Inf.
b. 19–2–09. d., London, 18–11–57.
Ens. 8–1–26 ... furl. 1842–5; Maj. 3–8–55; ret. as Hon. Lt Col. 23–7–56.

Son of Henry Hill, Capt. RN., and Caroline Bettesworth his 2nd. wife.

m., 29–8–44, Emma Harriet, dau. of Geo. Edw. Russell, MCS., Comnr. Ganjam [253]; she d., Shanghai, 7–10–50.

Oriental Club.

1829, appd. Asst. Survr., and posted to Ganjam Svy. under Snell [III, 104, 342]. Dec. 1832, arrd. Madras after leave to Malacca on mc.; left on 11th for Nellore, where he started trgn. and training appces. [255].

Dec. 1833 to Oct. 1834, to svy. of Kimedi in Ganjam during mil. opns. [10, 250, 253]. Appn. for tr. to GTS. strongly recdd. by Everest, who described him as "one of the ablest and most efficient of the Madras surveyors". Succ. Ward in ch. Trichinopoly svy. 1–11–34, moving party to Salem during fd. season [250].

Jan. 1836, again called to Ganjam, to extend svy. into Goomsur under the Comnr., Geo. Russell, continuing there till granted furl. on mc., reporting in Oct. 1841; "I have been constantly employed in the hilly tracts, and have suffered repeatedly from fever, and rheumatism succeeded the fever about 2 years ago. ... I had hoped that my natural good good constitution would enable me to carry out the survey of the Ganjam hills [253, 383; pl. 15].

"I have been disappointed, and am now so nearly crippled that I find it impossible to carry on the work. ... I have applied for leave to embark from Calcutta in January next, and proceed via Egypt [175, 250, 254, 368][5].

Made valuable reports on the Goomsur country and its Khōnd inhabitants.

On return from furl. Feb. 1845, posted to GTS., and took ch. of Coast Series from Calcutta down E. coast. Health suffered greatly during several years work in these unhealthy tracts, and he resd. in 1853.

HILL, Lawrence. Ben. Engrs.
b. 2–3–12. d. Jhālakāti, nr. Barisal, 24–9–44. MI. Greyfriars chyd., Edinburgh.
2/Lt. 11–12–29; Lieut. 20–5–39.

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[1] Sketch of valley of Koonar R., MRIO. 113 (8). [2] *JASB.* XXIII, 1855 (623–48); bot. colln. from E. Indies. [3] cf. *IO. Cat.* (479); *JASB.*, XI, 1842 (49–90), X, 1841 (797–815). [4] DDn. 593 (543), 11–9–54. [5] DDn. 403 (499–502), 10–10–41.

Son of Robert Hill, of Edinburgh, and Barbara Geddes his wife.

ed. Addiscombe, 1828–9; Chatham, 1830.

Conolly (88/172); Hodson, II (452).

1830, attd., with "guard of Sappers and Miners" to Boileau's svy. in Bharatpur[1], being allowed, Jan. 1831, 2 mo. leave to continue svy. work with Boileau [217–2].

Feb. to April 1834, being stationed at Delhi, made himself useful with Boileau and Everest on approximate series of Gt. Arc across Jumna valley. "Mr. Hill obtained leave for two months from Captain De Budé, but will have to muster at Delhi on the 1st March by running in from your camp and rejoining immediately afterwards [27, 106]"[2].

1834–5, on Shekhāwati expn. [272]. June 1835, took over svy. Cawnpore cant. on tr. of Wm. Jones to GTS. [431].

HODGES, Alexander [III, 458–9]. Ben. Inf.
bapt. 24–8–1800. d., Lucknow, 6–9–41.
Ens. 4–3–20 ... Capt. 12–10–34.

Son of Rev. Thos. Hodges of Ludlow, Salop, and Mary his wife.

m., Everton, 9–8–38 (not 1839 as in vol. III, 458). Hessy, dau. of Wm. Huffington, of co. Donegal.

Hodson, II (457).

1827, appd. Asst. Rev. Survr., Sahāranpur; Jan. 1828, to Sundarbans [8, 178, 192, 304, 392].

1831–4, in ch. rev. svy. Noākhāli Dist., and islands of Meghna R., including Sandwīp [206]. June 1834, to Calcutta, "suffering from a severe fever". Having completed rev. svy. of Noākhāli, started Siddons on Chittagong svy.; furl. from 7–10–36 [193, 347, 368].

HUTTON, Thomas. Ben. Inf.
b. Penang, 4–3–07.
d. Rājpur, nr. Mussoorie, 19–12–74.
Ens. 28–9–25 ... Capt. 27–10–38; inv. 24–12–41.

Son of Thomas Hutton, of Calcutta, agent.

m., 1st, Edinburgh, 10–6–31, Mary Dundas, dau. of John Jardine, sheriff of Ross and Cromarty; she d. Nimach, 4–9–34.

m., 2nd, Delhi, 25–2–36, Georgiana Fortesque, dau. of John Brown, surg., Ben. Med.

1828–31, furl. on mc., returning overland, *JASB.*, IV, 1835 (167);

Dec. 1837, appd. Asst. Rev. Survr.; joined Mainpuri svy. March 1838. Applied at once for sick leave to hills, and left 10–4–38, having "derangement of the lungs—violent and distressing cough—after a severe attack of smallpox". Asked for leave till 5th Oct. "to enable me to explore and report upon the geology and...natural history of the Spiti valley, in fulfilment of an engagement entered into with the Asiatic Society".

His report, for which ASB. granted him Rs. 1,000, was pub. *JASB.* VIII, 1839 (327–34. 901–50); IX, 1840 (489–513) 555–81); X, 1841 (198–228).

He cannot have taken much interest in his svy. appt. for, in spite of the plea of illness, he "proceeded with as little delay as possible to Simla, whence...I started on the 14th of May 1838. ... Commenced my notes from the military post of Kotgurh, where I arrived on the 19th of May". He never rejoined the Survey.

Was a prolific contributor to *JASB.* on subjects such as Himalayan Vulture Eagle—Fresh-water Shells of W. Himalaya—Lichens of the Himalaya—Flowers on the way to the Borendro Pass—Woollen manufactures of Khorassan—Spiders in Mirzapur—Zoology of Kandahar—Ornithology of Kandahar—Snow line in the Himalaya; *ASB. Centenary Rev.* (147).

JACOB, John. Bo. Art.
b. 11–1–12.
d., unm., Jacobābād, 5–12–58.
2/Lt. 11–1–28 ... Col. 20–3–57; Brig.-Gen.

Son of Rev. Stephen Long Jacob, vicar of Woolavington Somerset; bro. to Wm. Stephen [*inf.*].

ed. Addiscombe. CB. 1850.

DNB.; *DIB.*; *Bo. Cal. & Alm.*, 1847 (327).

1838, with Bo. Army in Sind; 1839, comdd. Art. in Kachi expn., NW. Sind.

MRIO. Misc., 2–O 39, sketch of Bukkur Fort with British camp, 10–8–39.

1839–40, employed in Gujarāt, Supt. of "experiments in boring for water"; survd. route from Gujarāt via Nagar Parkar to Hyderābād and Sukkur; Upper Sind, sketch from Sukkur to hills on W. [246, 283][3].

From Dec. 1841, comdd. Sind Irregular Horse; distinguished mil. and pol. services in W. Sind; left name to Jacobābād. Throughout his pol. career encouraged local svys. and maps, and died just as a rev. svy. party had start work in Jacobābād; *Rev Svy Reports*, 1857–61 (126).

JACOB, William Stephen. Bo. Engrs.
b. 19–11–13. d. Poona, 16–8–62.
Ens. 21–6–29 ... Lieut. 1–7–33;
resd. as Capt. 20–1–48.

bro. of John [*sup*].

m., in England, 17–9–44, Elizabeth, dau. of Matthew Coats, merch., late of Gainsborough; she survived him with 6 sons and 2 daus., and d. 8–9–98.

ed. Addiscombe, 1828. FRAS.

DNB.; *DIB.*; *RAS.* (*mn*), X, 1850 (22, 87); XXIII, 1863 (128–30), ob. notice; Conolly (89/106).

Arrd. India, 1831; 19–12–33, appd. asst. to Shortrede on Bo. trgn., conducting operations whilst latter was absent on rev. svy. duty; took over ch. Bo. Longl. Series, Oct. 1836 [4, 14, 72–4, 88, 356, 408].

11–12–36 to 8–1–37, with SG. at Kaliānpur, and greatly impressed Everest [40, 319]; BMC., 6–2–37, appd. 1st Asst. GTS. [107, 110, 145, 358–9].

Oct., 1838 to 21–5–40, sick leave to Cape, resuming ch. on return. Re-obsd. Everest's series of 1822–3 [III, 234–6], thus completing Bo. Longl. Series to Gt. Arc [74, 92–3, 239].

2–10–41, left Poona to assist Waugh on meast. of base-line at Bīdar, but prevented by ill-health from joining SG. at Dehra [55, 57]. To SG's. invitation to bring Bo. Trgn. party to work in Himālayan area, presumably on N. Conng. Series [71], said he would rather resign[4].

With view to long leave on mc., obtained services of Harry Rivers as asst., handing over to him 9–1–43. Sailed from Bombay 11th Jan., leaving SG. with high opinon of his talents [75, 360, 367, 464–6].

20–9–45, appd. Asst. Supt. Roads & Tanks, PWD. Poona, where he est. private obsy., and compiled cat. of double stars obsd. by him; frequent contributor to *JASB*[5].

CD. to M., 24–3–49, appd. Astr. in ch. Madras obsy. vice T. J. Taylor, assuming ch. 6–7–49; sick leave 1854–5 and again from 1858; SSI. to M., 9–3–59, resd. whilst in England.

1860, with official expn. to Spain for obsn. of total solar eclipse. Obtained grant from Parliament £1000 for equipment of obsy. at Poona, engaging to hold ch. for 3 years. Sailed in *Herefordshire*, 25–7–62, taking astr. obsns. for lat. and long. on board; comments on absence of card-playing "which often proves a fertile source of dispute".

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[1] DDn. 263 (175); BMC. 1–10–30.

[2] Boileau to SG. 30–1–34; DDn. 331 (21).

[3] MRIO., 64 (25); 112 (75); 118 (15); 121 (35); HMS. 552 (34–5).

[4] TS. 8/2; Bo. Longl.; DDn. 718 (133), Waugh to Rivers, 10–6–50.

[5] *MRAS.* XVII (79); Markham (92 n. 3).

Arrd. Bombay 7–8–62, leaving for Poona 12th; died two days after reaching Poona, from "violent liver attack".

Had bought "telescope of nine inches aperture" for use at Poona, made by Cooke & Sons, York, which was adv. for sale two years later by Rev. Dr. Jacob, Christ's Hospital, London.

JENKINS, Francis. Ben. Inf.
b. 4–8–1793. d. Gauhāti, 28–8–66; MI.

Ens. 2–12–11 ... Bt.-Col. 28–11–54;
ret. Feb. 1861; Hon. MGen. 31–12–61.

Son of Rev. Francis Jenkins, vicar of St. Clements, Truro, and Mary Buckland his wife.

Hodson, II (542–50).

1830–2: on pol. duty Arakan; on recce. tour with Pemberton from Arakan through Chittagong—Cāchār—Manipur—Nāga Hills—to Upper Assam [262]; *IO. Cat.* (299), sketch of E. boundary of part of Cāchār for tr. to Manipur, 1831–3 [262].

23–1–34, Commr. of rev. and AGG. in Assam till ret.; took important part in est. of tea industry [201–4, 303].

JERVIS, Thomas Best [III, 463]. Bo. Engrs.
b. Jaffnapatam, Ceylon, 2–8–1796.
d. London, 3–4–57[1].

Ens. 1–6–13 ... Maj. 28–6–38; ret. 30–12–41.

Son of John Jervis, MCS., of Staffordshire, and Elizabeth, dau. of Capt. G. F. Ritso, RE., of Polish descent. Bro. to Geo. Jervis, CE. Bombay 1848–51.

m., Mahābaleshwar, 15–11–30, Anne Sarah, dau. of Dr. Wm. Paget, ret. surg. HM. 48th Regt.

FRS.; FGS.; FLS.; FRAS.; FRGS.; MICE.

Markham (100–1); biog. under title *Thomas Best Jervis*, by son, W.P. Jervis, London, 1898; with portrait from oil painting by Hopwood, Bombay 1830, p. 322; another after ret., as frpce.; *JRGS.* vii, 1837 (127–43); viii (202–5); 27, 1857 (cx); *Geol. Soc.* XIV, 1858 (liv–lx); Frith (9–12); Conolly (104/58).

1819–30, in ch. svy. of S. Konkan, rev. and statistics for Commr. and topo. for DSG. [III, 126–7; IV, 306], drawing salary Rs. 300 pm. [III, 352]. On close of svy. reverted to Engr. duties, and in May 1830 submitted incomplete maps and memoirs to DSG. On claim for further remuneration, was promised extra Rs. 200 pm. from 15–2–26 to 31–5–30, "on handing up...a fair copy of your memoir, complete for publication, accompanied by maps, plans, drawings [III, 352]"[2].

By end of 1834 completed in spare time elaborate copy of his "statistical memoir", together with fair copies of certain of the maps[3], which he laid before Govt. with request for allce. higher than that promised in 1831. He asked leave to get them printed privately, with 100 copies reserved for Govt.; "I was given to understand all my labour would be fruitless, and that the papers would eventually be locked up...in the archives in India or England till destroyed by time, on account of the great expense and difficulty that would attend their publication. ... The maps for the Statistical Survey became totally useless, as the drawing paper did not keep, and they all had to be re-drawn" in 1835[4].

Though the Govr. noted that the maps shown to the Council "did Capt. Jervis much credit", he did not consider the allce. already promised should be increased. "The question should be referred to the Honourable Court, and as Capt. Jervis intends to proceed shortly to England, it may be there settled by the Home authorities. The plans should be sent to the Hon'ble Court, copies being previously taken here"[5].

The Directors were informed, 25–2–36, that "Capt. Jervis has completed his statistical report on the Konkan, and has furnished us with an original memoir on the revenue system and land tenures, ... accompanied by...statistical tables, ... and by a volume of maps and plans which are beautifully executed. ... He had our permission to take the original material...with him to England, and...we would recommend your Hon'ble Court to allow him to print it. ...

"Capt. Jervis having fulfilled his engagement, we have directed payment of the sum of Rs. 10,300, ... awarded to him in 1831. ... We have sanctioned an outlay of rupees nine hundred and sixty to enable him to make such copies as...should be left on the records. ... The original memoir, maps, and tables, have been entrusted to...Capt. Jervis, who will deliver them personally. ... He is not to print the work except with your Hon'ble Court's sanction. ... We have consented to take 50 copies, ... and at the same time... express the highest sense...of the character, professional skill, and talents of Capt. Jervis"[6].

Armed with this introduction Jervis arrd. home on furl. at end of 1836, and "met many distinguished scientists [438–9, 459]". He submitted his memoirs and maps to the Chmn. of Directors [300] with claim "that there is no more important and difficult portion of the British Indian Empire so exactly, accurately, and fully completed as the survey of the Konkan, ... which is from beginning to end entirely new, and was made by myself, ... as all the natives who filled the detail were instructed by myself" [242].

He claimed that his trgn. was in "remarkable" coincidence with the GTS., whereas his only connection had been with Garling's to the south, and Shortrede's very wild work to the north [72]. "I feel confident", he continued, "from the experience I gained in...this survey, that...nothing could preclude the possibility of completing the survey of every part of India with equal exactness...in a very short...time".

He appealed for a substantial grant to compensate for his not having been given maximum svy. salary at the time [III, 352], and concluded with the curious request "that, as the senior officer in the Department, your Hon'ble Court will...for your own interest...place me in such a situation as may enable me to do justice to your favour"[7].

He was certainly not the senr. officer in the dept., for that was Everest. He had been appd. asst. survr. 25–1–23 [III, 126, 463], and disch. in 1830. Bedford in Bengal had been appd. 27–11–21, and served continuously as Rev. Survr. from 19–12–22, and as DSG. from 11–6–32, whilst other Bengal rev. survrs. had far more unbroken years of service than Jervis. He was, however, accepted on his own shewing, and was two months later appd., "provisionally, Surveyor General of India", the Chmn. communicating the news privately to him in a letter of 23–8–37. In the official letter which followed, 20–9–37 [317], he was told that "The Court fully approve your proposal to devote the remainder of your furlough to an attendance upon the Trigonometrical Survey about to be carried on in Scotland, and to avail yourself of the other opportunities...of gaining a perfect knowledge of every late improvement" [306].

He was further granted donation of Rs. 10,000 in recognition of his work on the Konkan svy., over and above that promised in 1831 by the Bo. Govt., and paid in 1835.

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[1] MI. Withycombe Raleigh chyd. [2] BO RC. 669/1835 (287–90), 29–1–35. [3] *IO. Cat.* (439–40), Konkun Atlas; 20 items MS. [306]. [4] Jervis (194). [5] minute by Lord Clare, Govr. & C-in-C. 5–1–35, BO RC. 669/1835 (251–2); *JRGS.* XXVI, 1856 (cxxx); maps of Konkan. [6] Bo to CD., Rev. 25–2–36. [7] Jervis to CD., 10–7–37; 41 Dorset St., Manchester Sq., London; DDn. 407 (1–8).

The Directors were much impressed by the maps, and wrote out to Bengal that they were "connected with triangulation of the Grand Trigonometrical Survey, and...prepared for incorporation into the Atlas of India. We shall forward the sheets for the observation of the Surveyor General"[1]. But their geographer, John Walker, was unable to make anything of them, and the Directors had to call on the SG. to undertake the task [307–9].

Everest looked for more than mere beauty of drawing. He had already called for Jervis's records to be sent up from Calcutta, and, like Hodgson before him, had found no evidence of their being accurately based on rigorous trgn., nor of scrupulous svy. of topo. detail. The sections were "disjointed and confused", and the trgn. of such poor quality that he refused to assemble them for the Atlas, and asked that Jervis should do this himself [III, 126–7, 203, n.2 210, 463 ; IV, 308 362, 438].

This Jervis attempted after return to India at the end of 1839, coming over to Calcutta in 1840 to collect material[2]. He worked on this compilation at Bombay in his spare time, but had to leave it unfinished when he left India for good [308–10].

After his appt. as "provisional" SG. he had pursued his contacts in England, and in July 1838 a number of distinguished scientists addressed the Directors, urging that the svy. programme under Jervis should cover "an improved topographical map...accompanied by geological, statistical, and other information. ... Experiments with the Tides, ... magnetic dip. ... Verification of Standards. ... Pendulum observations" [105, 117, 438].

They invited Jervis to address a meeting of the Br. Assn. at Newcastle, 26–8–38, at which he gave a general review of the progress of Indian surveys and geography in the past, showing a surprising knowledge of the names of early survrs. He sketched his plans for completing "a topographical survey of British India...in about seven years" and in a supply. memo. recdd. "that the whole of the surveys, topographical, revenue, and maritime, ... should be placed under the sole direction...of the Surveyor General", who should be given a team of over 100 British Engineer officers, soldiers, and civilians, recruited and trained in England, partly from the OS. [357, 362]. He had his lecture, with the scientists' "address", printed for private circulation and sent a copy to Everest in India[3] [317, 438].

Everest had taken but little notice of Jervis's official appt. His health was now much improved, and he had every intention to remain until the Gt. Arc should be completed, but he was stung to the quick by the addresses sponsored by the Royal Society, of which he was himself a Fellow, which ignored him and his work, and assumed that Jervis was now on his way to India to succeed as SG.[4]. He retorted with a series of savage letters addressed to the Duke of Sussex, who had headed the list of signatories as PRS. [11, 438].

Jervis left England amid a chorus of good wishes. "We all regret extremely Jervis's departure. He has been on our Council from the day of his arrival in Europe, and both there and in every other place has helped forward the cause of geography, ... and we rejoice at finding him about to fill so important a post as Surveyor General, when he will... forward Geography still more[5]".

A belated tribute came from Burnes in Kābul, 2–12–40, "I cordially congratulate you on your succession to the honourable appointment of Surveyor General, and I wish you all success. ... I often look back on your kindness in first instructing me in the use of the sextant, and turning me out a thoroughbred surveyor"[6].

Shortly after his return to Bombay where he was posted as SE., Jervis—obviously unaware of the reactions expressed in the *Letters to the Duke*—wrote to Everest, 13–12–39, and got a reply that left him in no doubt as to Everest's determination never to make way for him, but accompanied by a friendly suggestion that they might meet. Such meeting never took place, and Jervis now asked that he might be appd. DSG. for S. India, with hdqrs. at Belgaum [317, 437–9].

His last hopes were finally crushed by the Directors' declaration that they could not allow any material change in the system of survey now officially authorised and conducted by Everest. If Jervis were to succeed as SG., his duties would continue restricted to trigonometrical, geographical, and topographical surveys [318].

In Aug. 1841 Everest wrote again saying that he would not be retiring till end of 1843 [325, 430]. Jervis thereupon asked permission, 25–11–41, to retire "from Dec. 30th next. ... My health is greatly impaired, and has never been fully re-established since I returned...in 1839[7]" [473]. He sailed from Bombay about 30th Dec., writing to a friend from Suez, 19–1–42[8].

He continued actively at work till his death. He had pub. his *Geographical & Statistical Memoir of the Konkun* at Calcutta[9]. In 1845 he edited a translation from the German of von Hugel's *Travels in Kashmir*[10]. He also ed. a vol. of *Memoirs, Voyages, & Travels, illustrative of the Geography & Statistics of Asia*, on which the *Cal Rev.* of Jan.–June 1845 writes; "About four years ago the Major projected an immense work on the Geography and Statistics of Asia. ... Without abandoning the original plan, the Major has adopted the...more practical one of publishing a series of important works in the form of Memoirs, Voyages, & Travels".

His most valuable contributions to geography were, however, in the line of map printing. He had always been interested in lithography, and "after his retirement...settled in London, ... setting up a lithographic press in his basement, and turned out prints of many plans and forms of his own design for use in India, including a map of the Island of Bombay as surveyed by Captain Tate, and also a one-inch pargana map [III, 168 ; IV, 313, 469 IV, 313, 469][1]".

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[1] CD. to B., Mil., 10–4–38 (46). [2] Visit also connected with his interest in mission work. [3] BM. Addl. MS. 14380 (5). [4] in letter to ASB., 1–8–39, RGS. refer to Jervis as SG. of India ; *JASB.*, VIII (864–5). [5] RGS. to Bo Geo Soc., Jervis (214). [6] ib. (215). [7] Jervis (218). [8] ib. (135–42). [9] *Progs. Bo Geo Soc.*, May 1840 (1–149) ; Aug. 1840 (78–9). [10] *RGS. Progs.*, XV (255).

A letter from Bombay, 18-6-43, acknowledges "the beautiful maps...of Bombay and Bokhara. They are excellent specimens of lithography. ... You mention being about to commence the map of the South Konkan. We have had the Tanna Collectorate already lithographed, ... and there is now in preparation in the Chief Engineer's office the Rutnagiri Collectorate. These are on the scale of four miles to an inch, but stand no comparison with your specimen[2]" [309].

He offered to litho. maps for ASB., but they preferred to patronize local presses, even though the work would not be so fine as that by Jervis[3].

He was himself "an excellent artist with pen and ink, ... and also in water colours", and admits "a love for geographical pursuits, the practice of all the artistic means in aid of these—lithography, engraving—as well as mathematics. ... The beautiful art of lithography which I had practised as an amateur since 1826 engaged my particular attention and I executed the Bokhara and Bombay maps among the first, and then a plan of Pekin. ... I trained a number of persons to carry out my views, and formed a small band of artists to prepare and publish all that is known respecting the geography of Asia[4]" [293 n.8].

About 1845, however, a "shortage of funds compelled him to sell his press and most of his library. In 1847 he settled in Clifton, and put in hand a 6-inch survey of Bristol which had to be abandoned". His greatest opportunity to turn his talents to public service was yet to come.

In 1846 he had pointed out to the Foreign Office—without result—the need for systematic colln. of infn. about the geography of foreign countries. "A department for the collection of information about colonies and foreign countries for military purposes...under the title of 'Depot of Military Knowledge' [had been] a branch of the Q.M.G.'s department" since 1803.

"On the outbreak of the war with Russia [1854], the Army was, however, quite unprovided with maps of the theatre of operations. ... Major Jervis was in Belgium, and while there was fortunate enough to obtain copies of the Russian General Staff map of the Crimea, and the Austrian military map of Turkey-in-Europe, both very rare maps, as they were jealously guarded by the respective war offices. ...

"Major Jervis, who had already transliterated and translated the Russian one, hurried home, and laid his maps before the Secretary of State for War, pressing the Government to authorize him to reproduce the maps for use in the Crimea. ... There was no precedent for such an expenditure, ... and Major Jervis was informed that...if...he would reproduce the maps at his own cost the Government would purchase as many copies as they might think desirable. ...

"Taking an office in Adelphi Terrace, so expeditiously did he work, that an English edition of the map of the Crimea, in ten sheets, printed by chromo-lithography in blue, black, and brown, was in the hands of the...staff before they landed in the country. At first the Government purchased but few ; the map, however, was found so invaluable at the seat of war that large numbers were eventually bought[5]. ...

"Major Jervis continued to press...the importance of instituting a Topographical Department, and...on the 2nd February 1855, was rewarded by...the sanction of the Treasury for the creation of a Topographical and Statistical Department in connection with the War Office, and offering him its superintendence.' The department was first housed...in Whitehall...and at 9 Adelphi Terrace. Subsequently, 1st August 1856, it was moved to 4 New Street, Spring Gardens.

"On April 3rd 1857 Colonel Jervis died, and... subsequent changes led to...the Geographical Section of the General Staff"[6].

JONES, William. Ben. Engrs.
b. 9-10-12. d. 11-2-71.

2/Lt. 8-12-31 ... Capt. 1-1-51 ;
ret. as Hon. Maj. 19-11-55.

Son of John Edward Jones, MGen., RA., and Louisa his wife.

ed. Addiscombe, 1830-1 ; Chatham, 1832-3.

Conolly (88/182) ; Hodson, II (569-70).

1833, with S & M. Delhi ; 1834, on Shekhāwati expn.

4-5-35, appd. 2nd. Asst. GTS. ; "My name was in General Orders of May 6th. On finishing the survey of Cawnpore (May 28th) [448] I proceeded by dak to Futtehgarh, where I joined Waugh, partly in the hopes of getting a wrinkle or two from him, and also in the expectation of being allowed to draw my pay from the day I joined him (June 1st). ... On June 4th I got your orders to proceed to Head Quarters at Dehra, where I marched on June 22nd. ...

"You have doubtless seen the comet ; he has got a famous tail. I first saw him on the evening of the 12th. Whose route is he following[7]" ?

1835-7, emp. on Gt. Arc under SG. [15, 39, 41 n.2, 154, 316, 330, 435] ; asstd. at meast. of Sironj base, Nov. 1837 to Jan. 1838 [53 n.2], and then given ch. of Karara Merdl. series. He reached the starting point, s. of the Son R. in Rewah, in March 1838. After selecting 5 stations, took party into Allahābād for rains [66, 141]. Starting out again on 1st Oct., the whole party was overwhelmed with fever, and returned to Allahābād. SG. ordered suspension of opns. and called Jones to join him at Kaliāna, where he and Barrow were working on the astr. circles [133-4].

Spending rains of 1839 at Hāthipaon, applied in Aug. to be sent on active service, "having observed in General Orders that a body of troops has been ordered to...the vicinity of Joudpore, and that there is a possibility of active service. I was prevented by severe illness from volunteering my services at the time the troops were ordered to Kandahar, and, should I allow this opportunity to pass unnoticed, it may appear that I am too much absorbed in my present employment to recollect that I am a soldier"[8] [357].

Govt. refused to release either Jones or Renny from their svy. duties, and in Oct. Jones set out to resume work on the Karara series. His health broke down yet again after the first 3 marches, and he had to return to hdqrs., and was allowed to remain in the hills [68-9]. After 12 months at Mussoorie, his services were replaced "at the disposal of the Commander-in-Chief[9]" [355-6, 367, 380 n.5].

From 1842, employed on canals in Rohilkhand[10].

KEWNEY, Henry. Ben. Inf.
b. 19-5-10. d. Karnāl, 4-11-38.

Ens. 10-5-28 ; Lieut. 22-4-36.

Son of Jones Kewney, of Nottingham and Grantham, hosier, and Charlotte his wife, dau. of Rev. Dr. Thos. Stanley, rector of Harston, Leics.

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[1] Jervis (53-5). [2] ib. (218) : from Sec. to Govt. [3] *JASB.*, XIII ; progs. of 6-11- & 17-12-44 (cxxiv). [4] Jervis (53, 171). [5] *Imp Lib M & P.* (514), Crimea map. 10 sheets. [6] Frith (4-12). [7] to SG., 17-10-35 ; DDn. 375 (7-9). [8] ib. (255-8), 15-8-39. [9] BGO. 202, 23-9-40. [10] *NWP. Sel.*, I, 1847 (xxi).

5 ;

Hodson, II (593). ; *Punjab Inscpns.* (195).

1832–3, opns. against Kols and Chuars in Chota Nāgpur [474]. Very modest about his useful rough svys. [268–9]. "I fear that it is but a very medium production in every part, particularly the writing of the names, in putting in which I found my hand so out of practice. ... If fault is found. ... I think I could manage something rather neater. As to the survey, ... I was completely unprepared to make it, and entirely destitute of instruments but such as I could, on the instant, make up with the assistance of native mistrys"[1] [300].

His maps are clear and legible, and one is decorated with a bold artistic sketch of the local people.

1835, DAQMG. Presdcy. ; 1836, to Malwa fd. force ; emp. on svy. Bengal and Narbada valley ; Sept. 1838, to Army of the Indus, but "committed suicide in a fit of temporary insanity brought on by overwork".

KITTOE, Markham, Ben. Inf.

b. 16–11–08. d. 18–4–53.

Ens. 12–5–25 ... dism. by ctml. 12–12–37[2] ; restored from 21–1–39 ... Maj. 5–5–51.

Son of Robinson Kittoe, RN., and Eliza., dau. of Geo. Dominicus.

m., Calcutta, 12–11–35, Emily, dau. of Maj. Robt. Chalmers (1788–1840), Ben. Inf.

Hodson, II (603–4) ; Colesworthy Grant, portrait, with planetable.

1836–47, frequent contributor to *JASB.* ; 1837–8, Curator and Librarian ASB.

6–10–36, submits journal of travels in Orissa, with reports on coal deposits ; 1837, with regt. at Cuttack, visits Talcher ; submit specimen of "good glistening coal", found at depth of 13 feet ; 1838, deputed by Coal & Mineral Com., to explore the supposed coal fields of Orissa ; "left Calcutta by dawk on the 23rd February. ... I carefully examined the bed of the Subanrika, but could not discover any...coal".

On return to Calcutta, deputed to complete svy. of Sambalpur–Midnapore road, left unfinished by death of Geo. Abbott [416]. "I left Calcutta for Cuttack by dawk on the evening of the 17th April, where I arrived on the morning of the fifth day. I travelled at night. ... I went on to Pooree where I remained three days, being completely overcome with the fatigue of so much dawk travelling, for it was but lately I had returned from my tour in Orissa in search of antiquities, coal, and minerals, etc.

"I left Pooree on the evening of the 26th, and reached Koordah early on the following morning. ... Puddum talaow, on the spot where I had encamped when with my regiment in June 1837". Sambalpur May 4th till 23rd, perambulator and compass svy. [260].

Returned to Calcutta in June, having travelled "upwards of 2,100 miles" between 16–12–37 and 5–6–38[3].

1842–4, furl. ; from 1844, on road construction with PWD.

1848–53, on special archaeol. duty, Bihār and Benares ; auth. of *Architecture of Hindustan.*

LANDERS, A. H. Mariner (?).

1834, J. H. Landers appears as Mariner in ship *Forth*, at Calcutta.

pr. kin to J. E. Landers, in Assam in 1845, and to Gen. J. E. Landers (1802–85) —son of James Landers, coal merch. of Culross, co. Fife—of Ben. Inf. ; MS. and ADC. to Presdt. of Council, Bengal, 1838 ; Hodson, III (9).

1839–40, A. H. Landers shown as "special assistant" in PA.'s office in the Khasi Hills[4], and described, *JASB.* IX, 1840 (202), as "a practical gentleman who has been appointed for the superintendence of coal mines in Sylhet and Assam".

Feb. 1845, "Capt. A. H. Landers" sailed from Calcutta for Moulmein.

MRIO. 157 (67), is an undated map of the Shan country beyond the Salween by A. H. Landers [265].

LAWRENCE, Henry Montgomery. Ben. Art.

b. Ceylon, 28–6–06. d. Lucknow, 4–7–57, of wound received 2nd July.

2 Lt. 10–5–22 ... Lt Col. 18–5–56 ;

Brig.-Gen. May 1857.

Son of Lt Col. Alexander Lawrence, HM. 77th Ft. and Catherine Letitia his wife ; eld. bro. of John Lawrence (1811–79), Viceroy of India 1863–9 & 1st Baron.

ed. Foyle Coll., Londonderry, Jan. 1815 to June 1819, with 2 bros., Alex. Wm. and Geo. St. Patrick ; John followed 1823–5 ; their uncle, Rev. James Knox, was hd. master[5].

1819–20, their father lived at No. 2 Bellevue, Clifton, and Henry and John attended as day-boys a school at No. 2 College Green kept by Rev. James Gough[6].

Addiscombe, 1820–2.

m., Calcutta, 21–8–37, his cousin Honoria, dau. of Rev. Geo. Marshall, rector of Carnodonagh, co. Donegal ; she d. Mt. Abu, Rājputāna, 14/15–1–54.

By coincidence, Henry Lawrence (1790–1887), Ben. Inf., m. Honoria, dau. of Sam. Hodgson, of Richmond, Surrey ; Letters often went wrong.

CB. 1846 ; KCB. 1848 ; ADC. 1854 ; Auth. of *Adventures of an officer in the service of Runjeet Singh*, fiction, 2 vols. London, 1845 ; had a ready pen, and was frequent contributor to press [449, 453].

DNB. ; *DIB.* ; *Ency Brit.* ; *Indian Officers* ; Edwardes ; *Rulers of India* ; Blunt (224–5/866) ; Hodson, III (26–7) ; Morison ; *Punjab Inscpns.* (202–3) ; Portraits, at *IO.*, Foster (xiii n.12 ; 213, 214) ; at VM., copied from one by Dicksee in Nat. Gall., Dublin ; at Foyle Coll. two oil paintings.

Founder of Lawrence Schools, Abu, Sanāwar, Murree, and Nīlgiri Hills ; MI. Sanāwar.

Burmese War, 1824–6, shared tent with Fordyce [443] ; 1826, leave on mc. to Penang, meeting Philip Jackson [III, 403] ; Aug., furl. to Europe on mc. from Singapore ; 1828, with Fordyce spent some months with os. in Ireland [90] ; returned Calcutta Feb. 1830 with bro. John and sister Honoria.

1830–1, at Karnāl with his bro. George, of Ben. Cav., James and Saunders Abbott, and James Brind. On Geo. visiting Simla, he asked GG. to appt. Henry to rev. svy. ; Simmonds also warmly commended Lawrence and Fordyce, and was asked by GG. if they were relations of his [408].

22–3–33, appd. Asst. Rev Survr., taking ch. of Moradābād svy. during Browne's absence on leave [214, 321 ; pl. 12] ; recdd. by DSG. for independent ch. ; "his successful experiments with the khusrah work have frequently brought...this young officer under the favourable notice of the Board[7]" [7, 362–3].

Oct. 1833, raised new party for Farrukhābād svy., moving it in to Gorakhpur (E) at end of 1835 [215, 225, 234].

DSG. compared Lawrence's outturn for 1833–4 very favourably with that of Simmonds in Azamgarh, the general conditions being much the same. Lawrence's "operations commenced late, and... native establishment was formed and instructed during the season of field work. For the first three months, moreover, that officer had two most troublesome...office assistants (since discharged), and afterwards two inexperienced lads in their place [388–9]. Yet, with the addition of the combined khusrah work throughout (from which Captain Simmonds was wholly relieved until near the close of the season), the area professionally surveyed at

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[1] to one of the Joint Commrs. 2–3–32 ; DDn. 282 (79). [2] *A. J.* XXV., 1838 (250). [3] MRIO. 46 (45–7), Routes, Chota Nāgpur ; 63 (23), Midnapore to Raipur, 160 m. w. of Sambalpur. [4] *B & A Dir & AR.*, 1845 (70). [5] Foyle Coll. recs. [6] Hatton (305), & *Bristol Dir.*, 1817–21. [7] DSG. to Rev. Bd. WP. 9–7–33 ; BRC., 2–9–33 (17).

Futtehgurh exceeds that of Azimgarh by 129,000 acres[1]" [222, 224].

A man of great physical energy and independent character, many tales have been recorded of his survey life. It was probably Saunders Abbott who writes; "The knowledge I had obtained of surveying at Addiscombe was only as the ABC to the science of the Revenue Survey of India, and in teaching me he never spared himself, but, having taught me, he never did anything I could do for him [417]. ...

"His great strength lay in ubiquity. Our survey covered a large area. Natives were extensively employed both in the scientific survey which laid down minutely the boundary of each village, its topographical features, area, etc., ... and the field survey, whereby each field was measured and mapped, its produce, soil, and capabilities recorded, and its total area compared with that of the scientific survey [231 ; pls. 8, 12]. ... A wide field for abuse and peculation lay open. ...

"His theodolite surveyor had extorted money from landed proprietors by pretending that the needle...would not act until it felt the influence of silver, on which the deluded zamindar, having placed a rupee or two on the instrument, by a sly touch the needle was made to fly round to its pole. ...

"He gave himself little rest, even at night. I was called up at all hours to take a meridian altitude of Sirius, or some other star, for the latitude, or an elongation of Polaris to test our meridian line, and not infrequently, more for fun than utility, for a lunar observation, which we called 'humbugging the stars' for we could seldom come within 20 miles of our exact longitude, and used to wonder how such very uncertain observations, with their intricate calculations, could be turned to account at sea [III, 101]. ...

"On one occasion after his marriage, we had to enclose a large tract of the Dhoon [in E. Gorakhpur], at a season... when Europeans had never ventured to expose themselves, so he took one side of the area himself, and gave me the other side, and we were to meet. It was a dense jungle at the foot of the Nepaul Hills, interesected with belts of forest trees, a famous tiger tract. Fires were kept constantly lighted to keep off the tigers and wild elephants, ... and it was not till 11 or 12 o'clock that the fog cleared sufficiently to permit of our laying a theodolite. It was in such a tract that, after 3 or 4 days, we connected our survey, and when we met, to my surprise, I found Mrs. Lawrence with him[2]".

He devised his own punishment for the misdemeanours of his men, having no patience with formal procedure. "A native surveyor who refused to go back some ten miles to revise a serious error...was laid upon a native bed, ... and carried by bearers to the spot, where he was turned out to rectify his error. The man was obstinate, refused to re-observe his angles, and returned to camp. ... Lawrence ordered him up into a mango tree, where he kept the recusant guarded by two burkundazes with drawn swords until hunger changed the mind and temper of the surveyor. The man ultimately proved an excellent worker".

He had specially applied for Abbott to be attd. to his svy. for training, that he might take sick leave to the hills in March 1837, when he went to Simla for several months [365, 417]. He liked to make touch with men of position, and had ideas of his own on many subjects of high military or civil policy, and was not shy of putting them forward, either in interview or on paper. Even the SG. was criticised; "I am not unaware that D.Q.M.G.'s do occasionally make road surveys, and sometimes even venture on a cantonment, but...we are still without plans of the greater part of our few stations, and correct maps of the few military roads in the country are scarcely procurable. Of the different surveys now going on throughout the country but little is known. 'What is the Grand Trigonometrical about' is a question often asked, and worth the Surveyor General's while to answer [440–1][3]".

He soon attracted the attention of the Rev. Bd., more especially that of Merttins Bird, who was most anxious to increase out-turn of svy., and thereby speed up and cheapen the settlement of revenues. He found in Lawrence a willing co-operator, and in 1837 issued instns. from the Rev. Bd., without consulting the DSG., which effected an annual outturn of 3,000 sq. m. for each party, instead of the previously accepted 1,000. This was of course, at the expense of precision that was of small importance to the settlement officers [214–8, 321–2, 421, 468].

"The Board...availed themselves of...Capt. Lawrence passing thro' Allahābād on leave to discuss with him in the fullest manner...regarding the details of the establishment. Capt. Lawrence is one of the most experienced and zealous of the officers...on the survey, and has conducted the complicated process of double survey more successfully, perhaps, than any other, and has certainly entered more entirely into the Board's views. Capt. Lawrence is prepared to guarantee a complete survey of 3,000 sq. miles per annum, where the villages average one sq. mile each [217–8, 234][4]".

Bedford, DSG., disapproved strongly of the change, and deeply resented the share that his young subordinate had taken in its introduction, but opportunity came for his tr. to the Lower Provinces, and tension was relieved [216, 322, 420]. James Thomason, Sec. to NW. Govt., writes to Lawrence, 15–5–38, welcoming the new scheme [471];

"Bravo! Hip, hip, hurrah! for the Extended Survey scheme. It will be excellent to floor B— ...with a few round figures of four places of square miles. I only hope Montgomery[5] won't let you off cheaply, but scrutinize your maps to the north. Next to the pleasure of flooring B—would be that of catching a crack surveyor tripping. ... I am glad to find my position for interposing Montgomery between Bird... and you, like a slice of ham between two crusts of a sandwich, answers so well. I should enjoy a meeting between you three on any professional question; Captain B—also joining by special invitation. I think Montgomery and I would have hard work to keep you all in your chairs[6]".

Others besides Bedford disapproved of this urge for speed; "A brother officer and contemporary[7]...broke out in loud vituperation against Lawrence for doing so much work, saying 'his confounded zeal' had given them twice as much work to do as formerly; that Mr. Bird...had hauled them over the coals for not doing more work, and pointed out that Lieutenant Lawrence had done twice the amount[8]".

Lawrence was on leave in Simla when Honoria Marshall's ship anchored off Calcutta 8–7–37; she writes; "Henry had had severe illness last September [1836], which obliged him to try change of air, so he went in March to the Himalayas[9]. ... He was with me August 17th; August 21st we were married". Sept. 5th, embarked at Calcutta [river journey]—Monghyr, 2nd October—to Gorakhpur—Camp.

18–12–37. "Henry is...on the Revenue Survey, that is, surveying accurately the country with a view to the fair assessment of the revenue which chiefly arises from a tax on the land. He is the head of a party. Three gentlemen are his assistants, besides an office where there are English and and half-caste young men, and some hundred of the native establishment for measuring, writing, copying. ...

"We take the field about the first October, and remain in camp till May or June. Henry and his assistants have detached camps at different points of the district, ... and as each part is finished, our camps move. Last year Henry surveyed 1,400 square miles. ... We are on the eve of a march of 200 miles; this district being finished, Henry is ordered to Allahabad" [216, 220, 234].

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[1] from DSG., 12–9–34; BTC., 20–10–34 (49). [2] *Indian Officers* (281, *et seq.*). [3] Edwardes (171–5). [4] from Rev. Bd. WP., 11–9–37; Edwardes (85, 124). [5] Collr. Allahābād, where Lawrence was now working [225 n.1]. [6] Edwardes (113 n.). [7] possibly Shakespear [465]. [8] Edwardes (85). [9] ib. (105–12) extracts from letters and diaries of Honoria Lawrence.

11–2–38. "Our march of less than 200 miles occupied nine days. ... We do nothing but travel. Since I left England, except for the two months I was at Cossipoor[1], I have only been for a few days at a time within a house, and very seldom so much as a fortnight in one place. ... Hitherto I have accompanied him everywhere [453], and have seldom been even for a morning parted from him. ... We sit almost invariably in the same tent, and even though I may not interrupt him by speaking, I can sit by him, following my own occupations, while he works at his maps and papers. ...

"He is thirty-one, but looks older, is rather tall, very thin and sallow, and has altogether an appearance of worse health than he really has. ... Very active and alert in his habits but very unmethodical. As to dress and externals, perfectly careless, and would walk out with a piece of carpet about his shoulders as readily as with a coat, and would invite people to dinner on a cold shoulder of mutton as to a feast".

Allahābād : 3–5–38. "Mr.— is a broken-down surveyor[2] whom Henry is trying to re-establish, I fear with little prospect of success. ... Mr.— is a careless, extravagant, man, but his wife is a quite nice little woman, ... having just lost her only child. So we have asked them to spend six months with us, Henry giving him work".

Warned for mil. service, handed over ch. to Saunders Abbott ; joined unit at Karnāl Oct. 1838, but found it was not destined for the front line [226, 368].

14–1–39, appd. asst. to PA., Ludhiāna, and on 21st to civil ch. at Ferozepore ; 31–3–40, asst. to AGG. NWF.

He had few compunctions about leaving the survey for a political career ; he was wise, for the rev. svys. of the NWP. were closed down during 1842 [220]. His bro. John writes to him, 21–1–39, "You are well out of the Survey ; besides, the political is the best line". Another civilian wrote to him him, 28–1–39, "Lord Auckland says there is a great deal of difference between knocking about with a theodolite all the hot weather, living in tents nine months out of the twelve, and sitting with one's heels on the table playing civilian, and that he will not give for the Ferozepoor appointment more than a consolidated allowance of 700 rupees [a month][3]. You must, therefore, determine whether you will remain at Ferozepoor on that, or go back to the Survey. I suspect you will remain, for you are in the way to future promotion and distinction in the political line, which you would not be in the Survey"[4].

Held succession of important pol. posts [417] the last being Ch. Cmnr. and AGG. Oudh from March 1857, where he perished in the defence of Lucknow Resdcy.

LECKIE, John Davies. Bo. Inf.

b. 25–3–12 d. 3–10–72.

Ens. 5–4–28 ... Bt.-Maj. 20–6–54 ;
ret. as Hon. Lt Col. 16–12–56.

Son of John Leckie, of London, late merch. of Bombay, and Ann Malcolm his wife.

m., 20–11–45, Henrietta Matilda, dau. of Sir Henry Thos. Oakes, 3rd. Bart. ; she d. Southsea, 11–6–81.

Jan. to Nov. 1831, with Burnes from Māndvi, in Cutch, up the Indus and Punjab rivers to Lahore and Simla [243, 274, 424], being then recalled to Bombay ; "young, active, and intelligent".

Employed later on pol. duty, Gujarāt.

LEECH, Robert. Bo. Engrs.

b. 7–12–13 ; bapt., St. Helena.

d. Ambāla, 2–9–45 ; MI.

2/Lt. 8–12–31 ... Lieut. 28–6–38 ; Maj. (local), 7–8–38.

Son of Richard Huddart Leech, St. Helena C.S., and Eliza his 2nd wife, dau. of Lt. Andrew den Taaff, St. Helena Inf.

ed. Addiscombe & Chatham. Conolly (106/98)[5] ; *Punjab Inscpns.* (204). CB. Dec. 1842.

1836–8, with Burnes from Bombay to Sind, and up Indus R. on 'commercial" mission to Kābul, being responsible for mil. recce. report [426]. With Lord, visited Multān when passing Dera Ghāzi Khān. With asst. James Nock [278 n.4], survd. Khyber Pass, returning via Kandahār and Bolān Pass [244, 277, 279–80].

1838–9, with Army of Indus to Kandahar and PA. there ; 1841–2, on pol. duty, taking part in defence of Kalāt-i-Ghilzai[6], till relieved by Nott's force, Aug. 1842.

A devoted student of languages, prepared grammars and vocabularies of languages of Punjab—Baluchistān—Ghilzai—Hazāra—and a paper on Sikh religion[7].

1844, 1st Asst. to AGG. NWF. at Ambāla ; submits map of "the Kuruk Ghetr", acknowledging loan of svy. insts. by Abbott, and help of "the Rajahs of Pateala and Jheend, and the Surdurna of Thanesur, for their ready permission to survey such part of their territories" [417][8].

JASB. XIV (civ), 3–10–45, regrets his "sudden death... from excessive mental labour".

LLOYD, Richard. Bo. Mar.

b. 1797/8. d. 19–11–77, aged 79.

Mdpn. 14–11–14 ... Comdr. 13–2–33 ; ret. 3–8–42.
Mar. SG. 1833–49 [261 n.4].

m. Maria, dau. of Daniel Ross (1780–1849), Mar. SG. [III, 400] ; she d. 15–3–41, aged 28.

Markham (27–28).

Low, I. on svy. under Daniel Ross, from 1823 [114]. 1833, survd. inland waters, Arakan ; 1835, survd. Hooghly R., from mouth to Calcutta, connecting with base-line on Barrackpore Rd ; chart pub. London 1839 [114, 261 n.4].

1840, completed svy. of sea-face, Chittagong to Hijli in Midnapore, reporting "swatch of no ground" off mouth of Hooghly [207]. Survd. Chittagong R., and parts of Mergui coast and archipelago.

Succ. as Mar. SG. by Comdr. Robt. Lloyd.

LOGAN, George. Asst. GTS. ; uncov.

b. c. 20–5–09.

d. Mussoorie, 10–6–54 ; MI.[9]

ch. of SGO. obsy., Calcutta, 11–3–31 ; 2nd. Astr. Asst. 16–1–34 ; 2nd Asst. GTS., 3–10–36 ; 1st Asst. 17–6–42.

Eld. son of Thomas Logan of Duns, Berwick, and Elizabeth his wife ; related to James Herbert [III, 457 ; IV, 380] ; his yr. bro. Abraham (1816–72), barr., went to India and then to Penang where he died. There were several Logan's in Bengal, 1830–40, indigo planters[10]. A Catherine Logan, dau. of Robt. Logan of Edinburgh, m., Cawnpore, 21–1–39, Capt. Wm. Freeth (1805–86), Ben. Inf.

m., in India, Charlotte, dau. of James Manson (1791–1862), Ben. Inf. [III, 484] ; she d. 1900.

A son of Geo. Logan—but possibly not the survr.,—of HM. 2nd Dragoon Gds., m. at Mussoorie, 8–9–63.

Logan-Home, *History of the Logan Family*, Edin. 1934.

arrd. India 22–9–30 ; 11–3–31, appd. to ch. SGO. obsy. on 3 y. contract, vice Rees, drawing Rs. 150 pm., with Rs. 100 extra on leaving Calcutta [114, 138, 340, 371, 379, 402]. Asstd. on meast. Calcutta baseline [49–50, 352].

1832–3, with fd. office by boat from Calcutta, holding ch. of insts. at Sahāranpur [139, 165, 170, 172].

On expiry of contract, retained as 2nd Astr. Asst. on Rs. 250 pm. and on Everest's strong recdn. promoted to officer status ; asstd. on meast. base-lines

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[1] a suburb N. of Calcutta. [2] not identified. [3] compared with Rs. 900 in svy. [4] Edwardes (141). [5] Conolly wrongly gives spelling Leach. [6] Sandes, I (276). [7] *JASB.* VII ; VIII ; XIII ; XIV. [8] ib. XIV, 1845 (lix). [9] MI. in good condition 1951 ; model of tomb, GBO., Museum. [10] *Ben. Dir. & AR.*, 1835–42.

Dehra, Sironj, and Bidar: 12–7–39, salary increased to Rs. 400 pm. [49–50, 52, 55].

27–4–42, promotion to 1st Asst. ordered by Directors [380]. Emp. on Gt. Arc till appd. to ch. of **Chendwar Merdl. series 10–9–43** [3, 35, 39, 41 n.2, 59, n.1, 64, 99, 135, 320, 376].

Quite the best of Everest's civilian staff, and fully equal to the mil. officers in general ability and reliability; held ch. of trig. parties till death from dysentery after long illness.

In announcing his death, the SG., Waugh, records that "although his mathematical acquirements were limited, his skill as an observer was of the highest order, while his sound judgement and industry secured...success in all his undertakings. His foresight and sagacity in arranging for every contingency were at all times remarkable, as was also his thoughtfulness for the welfare of others [319].

"His activity and zeal were always untiring, and his spirit was never daunted by any difficulty[1]".

MACDONALD, Roderick [III, 474].
b. 12–4–04. d. Edinburgh, 3–3–37;
MI., St. Cuthbert's chyd.

Ens. 23–2–22 ... Bt. Capt. 23–2–37;
furl. on mc. 5–4–36.

Son of Alex. Macdonald, HM. 34th Ft., and Christian Macleod his wife.

ed. Sandhurst. Hodson, III (127).

24–1–28, appd. Asst. Rev. Survr., Sahāranpur; 30–1–29, tr. to Sahaswān under Bedford [362, 368, 387]; 1–3–31, 7 mo. leave to Simla on mc., followed by 3 mo. to Calcutta; abandoned idea of furl.

12–3–32, tr. to GTS., leaving Calcutta 23–11–32 to ch. Budhon series, to work N. from Saugor [3, 4, 24, 137, 143, 172, 175, 353–5, 407]. A particularly competent survr., Macdonald had knack of writing most interesting reports [61–3, 91, 161–2]. He describes many exciting incidents in a country held by petty Bundela chieftains, whose territories were not remarkable for law and order.

The local people had a particular propensity for destroying svy. station marks, as already noted by Olliver [86]. In appealing to Govt. to allow more vigorous action to prevent such wanton interference, Everest urged that steps should be taken to persuade the more intelligent of the leaders "that the operations of the G.T. Survey were not in any wise connected with the black arts, or with the finding of gold, but were purely to find out the length, breadth, and thickness of the Earth. ... Lieut. Macdonald, from his knowledge of the native language and character, and the general mildness of his manners, is admirably calculated to support such explanations, but mildness alone will not answer, and unless it be backed by power is of no effect[2]" [152, 161, 266].

Everest considered him good with the training of young appces., "for, as they are all raw lads fresh from school and full of boyish habits, there was no measure so likely to be efficient in training them, as that of placing them under the orders of an officer so remarkable for...subordination and regularity, as well as his gentlemanly deportment[3]" [372].

May 1835, Macdonald had to seek med. advice at Agra "in consequence of one of my eyes having been seriously injured. ... No hopes are held out of being able to return to my duty for the present and...it may be necessary for me to proceed to the Presidency for medical treatment, and probably to Europe for change of climate[4]". Held on till first week of Sept., when he handed over to Ommanney, and started down to Calcutta, after nearly three years continuous service in a most unhealthy climate, with but few months shelter each year, and no change to the hills. Granted furl. four months later, and d. at home the following year [367, 459].

McLEOD, William Couperus. Mad. Inf.
b. Pondicherry, 16–9–05. d. 4–4–80.

Ens. 27–4–22 ... Gen. 1–10–77.

1820, "of the Borline family", father dead, and mother living in India.

m., Calcutta, 28–12–40, Jane Anne, dau. of Donald McLeod, IG. Army Hosps.

1833–4, asst. to Resdt. at Ava; survd. route up Chindwin R., and on to Manipur, sending specimen fossils and minerals to ASB.[5]

1836 and 1839, with Richardson from Moulmein to Chengmai and Bankok [264–5, 463]. Continued many years on pol. duty in Burma.

1841, *IO. Cat.* (471), supervised compn. of "Map of Toorkistan and Western Tartary", 36 m. to inch.

MACPHERSON, Samuel Charters. Mad. Inf.
b. 7–1–06. d. Calcutta, 15–4–60.

Ens. 28–2–27 ... Capt. 18–1–45; Bt. Maj. 20–6–54.

Son of Dr. Hugh Macpherson, professor of Greek, King's Coll. Aberdeen and Anna Maria Charters his 1st wife.

ed. King's Coll., Aberdeen, and Trin. Coll. Camb.

CB., posthumous.

DNB.; *DIB.*; *Oriental Club*; Macpherson.

MGO., 24–6–31, appd. Asst. Survr. Hdbd. svy., joining 20–9–31. He wrote, Vizagapatam, 4–7–31; "I have been appointed to the staff as Assistant Surveyor General [361]. ... The six fine months of the year I shall pass...in my tents. The remaining portion, given to rain and heat, I spend in Hyderabad with the best society, and the best library that Southern India affords [256]. ...

"In the last 3 months...my pay has risen from 180 rupees p.m., and ensign's allowance, to nearly 500 rupees a month, being about double my lieutenant's pay. I have, however, to keep up a large marching establishment of tents, palanquin bearers, servants, horses and bullocks, at very heavy pay, from my being perpetually on the move in by far the most expensive province of all India. In the season of vacation I hope...to carry on my geological plans, reporting progress to the Bengal Asiatic Society[6]. The trying portion of my new business will consist in taking eternally recurring angles with an instrument in the afternoon while the sun is clear; being sad work for my eyes".

Secunderābād, 23–10–31. "You must know of Colonel Lambton, and his...measuring the arc of meridian in India. I am employed in completing his work. Not with his view, to ascertain the form of the planet, ... but with the geographical and highly patriotic object of putting everything in India, for once, in the right place, by means of triangles subordinate to those measured by the great geodesist. ...

"I frame a geological map as we proceed over the land, and in the general memoir of each district...the matter which we record...of physical geography and general statistics is limited only by our plans of research. ... The use of the theodolite, the bother of logarithms, and minute map drawing in which my duty consists, are enough to eliminate the eyes of a lynx"[1].

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[1] DDn. 547 (236), 12–6–54. [2] DDn. 286 (108–9), 21–11–33. [3] Report, 21–8–39; 34. [4] DDn. 572 (237–8), 16–5–35.
[5] *JASB.* III, 1834 (365, 475). [6] *As R.* XVII, 1833 (115–21); *On the Geology of the Peninsula.*

nr. Hyderābād, 21–11–32. "In each survey are attached two officers, one in charge, the other assistant, and, ... eight or ten half-castes, generally well educated for that class, and all educated for the survey, but desperate blunderers the best of them, and...least of all to be trusted in taking angles delicately with the theodolite from the hill tops" [381]. As a matter of fact Madras sub-assts. were excellent planetablers and dmn., seldom empd. on trgn.

About this time Everest was casting round for recruits likely to make good in the GTS. [351–3], and Macpherson, who was now acting in ch., pending the arrival of Du Vernet, writes; 27–11–32, "Hyderābād, Jungle. My immediate superior of the upper provinces writes as highly gratified with my geological work, ... and promises to have me removed to Bengal to afford him immediate aid in...our grand and delicate work, the measurement of a base. ... There are two distinct surveys now going on in the land, one the geographical, in which I am engaged, the other...the grand trigonometrical, ... to ascertain the length of a degree of the meridian".

Macpherson was not alone in being impressed more by the contribution of the GTS. to our knowledge of the figure of the Earth than by its more immediate and practical purpose of providing a accurate framework for other surveys [440–1].

We do not hear whether it was eyesight alone which prevented his tr. to GTS., but he was obviously apprehensive; "With Everest I shall have terrestial observations by day, and celestial by night, ... and shall be thought nothing of if I am not a very Chaldean, and a speller of micrometers to millionth parts".

He took leave on mc. from 20–2–33, rejoining Hdbd. svy. till tr. to ch. Nellore svy. from 1–7–35 on Snell's retirement. "One of our 3 Madras surveys having become vacant, I am appointed to the charge of it, which makes me...very fortunate, as since I entered...I have only served...as a subordinate for a few months. ... My new ground is in the Company's country [255]".

Under C-in-C. order of 7–6–36, Macpherson joined his unit, 8th MNI., in Goomsur for "operations against the zemindar of Goomsur in Orissa [253–4]". The Madras Govt. had pressed the *zamindar* for arrears of tribute, which roused a rebellion, which was being put down by Madras troops, who now made their first contact with Khōnds. Macpherson writes, 20–12–36: "The war still drags out its weary length. Eight... regiments against the chief and about 50 followers [pl. 15].

"When my corps...was permitted to retire to its cantonments in the rear, ... I was ordered to...survey a portion of Goomsur Zemindary. ... Number of sick amongst troops about 400". In 1837, "Stevenson asked me to undertake a mission of survey and inquiry into the unexplored country. ... The unhealthy season had set in. ... I succeeded in my objects beyond expectation, but was struck down by fever and blindness". His svy. covered the N. part of the Khōnd country towards the Mahānadi. After the middle of Nov. 1837, resumed ch. of Nellore svy., his health much shaken.

1839–40, leave on mc. to Cape, handing over ch., 5–3–39; furl. to Europe would have entailed surrender of appt. [I : 207]. On return resumed ch. of Nellore svy. Feb. 1841, and with letter of 21–6–41 submitted belated report on work "in Goomsur and Souandah during...1836 and 1837". This report contains detailed descriptions of Merriah human sacrifices[2]. MGO., of 27–7–41, appd. Asst. Agent to Govr. of Madras in Ganjam, and 1842–4 held ch. of opns. for suppression of sacrifices. Furl. on mc. 1844–5, [10, 302, 368].

Nov. 1845 to 1847, was AGG. "for suppression of Merriah sacrifices and female infanticide in the Hill Tracts of Orissa", taking sick leave again to England.

His first campaign against these horrible practices was not entirely successful; "The Boad Khonds voluntarily agreed to give up the sacrifice, ... but the Rajah...impressed them that the Government...only wanted to tax the hill country. ... They accordingly attacked Macpherson, and compelled him to give up the children he had rescued, and to leave the country"[3].

Held pol. appts. at Bhopāl and Gwalior, 1854 till death.

MARGARY, Henry Joshua. Bo. Engrs.
bapt. 22–8–11. d. 21–1–76.
2/Lt. 10–12–30 ... Lt Col. 27–8–58
ret. as M Gen. 1–9–63.

Son of Joshua John Lloyd Margary, and Elizabeth, dau. of Thos. Sherwood.

ed. Addiscombe. *DIB*; Conolly (106/94).

m. Louisa, dau. of Rev. Brownlow V. Layard, of Uffington.

MRIO. 117 (9), svy. Karāchi to Sukkur, Oct. 1839.

MASSON, Charles. Traveller & Author.
b. *c.*, 1798[4].

Auth. of *Narrative of Journeys in Balochistan, Afghanistan, the Punjab, and Kalat*. 4 vols. London. 1842–4 — *Narrative of a Journey to Kalat, ... Peshawar*, 1843 with map — *Travels in Balochistan*...2 vols.

1840, aided by Henry Pottinger and Horace Wilson, narratives sold to publishers for benefit of Masson's mother, then living in London.

JASB. III (195); VIII, 1838 (1047–60); *Bo Geo Soc.*, I (9); 1839 (34–123); *Cal Rev.*, I (449); Holdich (ix 346–407); Vigne, II (vii); Grey & Garrett (176–210); Mohan Lal (304).

"Formerly a private soldier in 3rd Troop, 1st Bde. Bengal Artillery, his real name being James Lewis", deserted shortly after siege of Bharatpur, 1826, and spent next 15 years travelling beyond NW. frontiers. Assumed role of American to cover status of deserter.

Whilst with army had worked for Thomas Hardwicke [I : 338], arranging his geol. collections[5].

Not a survr., but, writes Holdich, "nothing seems to have come amiss to his inquiring mind. Archaeology, numismatics, botany, geology, and history. ... The route is described with surprising exactitude, and it has only lately been possible to verify step by step the road he travelled. ... As an explorer in Afghanistan he stands alone. His work has never been equalled, but...it cannot be said that his contribution to exact geographical knowledge was commensurate with his extraordinary capacity as an observant traveller[6]".

Grey & Garrett (178–9) describe him "clothed in Afghan garments, but more or less ignorant of the Afghan language, living with the people, partaking of their hospitality, studying their ways, joining their pursuits, discussing their politics. ... Fifty years elapsed before the footsteps of Masson could be traced with certainty. Not until the conclusion of the last Afghan War [1879–81], and the final reshaping of the surveys of Baluchistan could it be said exactly where he wandered. ... And now that we can take his story in detail, ... it is marvellously accurate in geographical detail" [444].

Notes on his collections of coins and other antiquities recorded in *JASB.* III, 1834 (329–32); IV, 1835 (234) V, 1836 (1–28 ; 537–53 ; 707–20).

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[1] *Macpherson* (20–4).

[2] pub. Calcutta, 1842; reprinted 1863.

[3] *Ben. Sel.* 1908; Cuttack; cf. Maltby.

[4] about 32 y. old in 1830.

[5] Grey & Garrett (194).

[6] Holdich (407).

Acted as "news-writer" for Govt. of India on salary Rs. 250 pm. and granted King's pardon for desertion[1] [426, 444].

4th vol. of his narrative contains map of his routes.

MATHISON, Robert. Ben Inf.
bapt. 7–12–07. d. 1–4–87.

Ens. 19–1–28 ... Capt. 1–6–51 ; Bt. Lt-Col. 28–11–54 ;
ret. 9–12–54.

Son of John Mathison, of Sec.'s office, EI Ho., and joint editor of EIR., 1803–14, and Lydia his wife, dau. of F. C. Pitman of Bencoolen est.

m., Calcutta, 15–5–41, Laura Elizabeth, dau. of S. T. Carter, Comdr. RN.

2–10–37, examined by J. W. Fraser and Rigby for appt. to rev. svy. ; "must at one time have been a good surveyor, well acquainted with the theory & practice of the profession, but...has neglected to keep up the knowledge acquired in England. Some of the answers...were so unsatisfactory that we do not conceive...Lieut. Matheson is fully qualified to undertake...a survey. ... Has produced to us several well executed plans & surveys furnished by him in England. ... He will be, when he has recovered by study the knowledge he once possessed, well qualified to fill the situation of Assistant Surveyor"[2].

Having allowed him a week "to recover his knowledge", the same board had "no hesitation in submitting...that he is well qualified" [304].

16–4–38, appd. Asst. Survr. on Rs. 250 pm., with an extra 100 "for wear and tear of instruments" [147, 347]. Appd. at same time Depy. Collr. with authority to settle boundaries. Took ch. of rev. svy., Midnapore 9–5–38, with Hijli in addition after departure of Egerton [403, 433]. Showed "energy and good management"[3] [178, 188–91, 208].

BGO. 6–2–42, directed him to join mil. unit at Ferozepore ; cancelled on protest of DSG. and Rev. Bd. [191].

30–3–41, Rev. Survr. on salary Rs. 526 [365–6].

Handing over ch. Midnapore svy. 1–8–44, sailed for England 15–10–44, with furl. on mc. till 23–11–47 ; Regtl. duty till ret. in India, 1854 [368].

MAXWELL, William. Ben. Art.
b. 9–7–14. d. 30–1–82.

2/Lt. 8–12–31 ... Col. 30–9–65 ;
ret. as Hon. M Gen. 1–8–72.

Son of Rev. Peter Benson Maxwell, of Birdstown, co. Donegal, and Hester O'Hara his wife.

m., 1st. Ghāzipur, 1–10–40, Mary Isabella, dau. of J. H Matthews, Pymr. HM. 31st Ft. ; she d. Naini Tal, 29–2–55.

m., 2nd. Āligarh, 16–1–57, Augusta Anne Susan, dau. of Henry Doveton, Ben. Inf.

ed. Addiscombe, 1830–1.

GO. NWP. 22–10–38, appd. Asst. Rev. Survr., joining at Agra under Fordyce [222–3] ; 25–9–39, took over ch. ; BRC., 18–3–41, appd. Rev. Survr. on full allces. ; 1840, moved party to Ghāzipur, and, GO. 14–7–41, to Patna in Nov. 1841 [149, 178, 184–5, 215, 229, 362–3, 368].

BGO., 15–7–42, to join unit for mil. service ; resumed ch. of svy. at Patna 6–2–43, moving party to Sāran at end of year [366, 471 ; pl. 8].

13–2–44, services replaced at disposal of C-in-C. ; later served on canals, and with PWD.

MOHAN LAL, Munshi. Traveller & Diarist.
b. Delhi, 1811/2. d. Delhi c. 1870.

Dec. 1831 to Feb. 1834, with Burnes' mission to Bukhāra, and returned with Gerard to Lahore [274–7].

"Son of Pandit Budh Singh, Brahman, son of Raja Mani Ram, of Kashmir descent". Budh Singh was resdt. of Delhi, and accd. Elphinstone's mission to Peshāwar 1809–10 [II, 65–6].

"Receiving the ordinary Persian education at home, ... sent...to join a small English class...established in the Persian College at Delhi. ... One of the first six pupils. ... My course of instruction in the English language lasted only three years[4]". Befriended by Brinsley Fitzgerald and C. E. Trevelyan, both of BCS[5].

DIB.

Auth. of *Journal of a Tour through the Panjab, Afghanistan, Turkistan, Khorasan, and part of Persia*, in company with Burnes and Gerard ; Calcutta, 1834.

Assumed title *Munshi*, primarily a Muslim designation.

18–12–31, invited by Burnes to acc. him "to Turkistan in the capacity of Persian Munshi, on a respectable salary"; ... left Delhi 20th Dec. to join Burnes at Ludhiāna on 30th [274, 276].

Kept journal of journey to Bukhāra and Meshed, where Burnes left the party, and Prince Abbas Ali of Persia invested Mohan Lal with the "gold medal of the Order of the Lion and the Sun". 29–9–32, "Mr. Burnes at noon started for the Caspian Sea. This unexpected separation was very much felt by me. ... I accompanied him about two miles, where he squeezed my hand, and said he would be happy to hear of my safe arrival in India" [424–6].

Leaving Meshed with Gerard 5–12–32, stayed several months at Herāt before returning to Lahore 30–1–34 via Kandahār, Kābul, and Peshāwar, keeping diary with notes. "I was very coolly received by my countrymen at Dihli, who...considered me a Musalman in consequence of crossing the Indus, or forbidden river. ... But I did not take any notice of them[6].

Took Gerard's despatches down to Calcutta where he delivered to James Prinsep [III, 405], Sec. ASB., "the collection of coins and other curiosities" made on the journey. Stayed with Trevelyan[7], who introduced him to ASB., and "gave him several hundred rupees worth of books" ; *JASB.* III, 1834 (363–4).

Whilst at Calcutta took "a regular course of instruction in surveying, and the Sabbath morning is the only one which did not behold him and his teacher busily engaged in taking angles and measuring with the chain". He conceived plans for a journey into Central Asia, of which the diary would "contain sketches of noted places, as well as a map of the country ; for the elements of surveying I have lately learned from Mr. J. Rowe, a gentleman of a kind disposition, and well skilled in that branch of science, who was recommended to me by Mr. C. E. Trevelyan".

Josiah Rowe was survr. to house-builders in Entally, and after 1847 appears as Survr. & Supt. of Roads and Conservancy, and Ex. Officer for the town of Calcutta[8] [III, 448].

Narrative of journey, 1831–4, was pub. in form of journal with help of Robt. Pemberton [III, 493–4] and "Mr. Jackson". It is full of interesting infn., ringing with the note of truth, and brightened with "tales of the countryside". His company and staunch loyalty must have been of the greatest value to his British leaders, and though he did none of the svy. his regular journal must have been of considerable help. He was only 22 years old in 1834 [401–2, 444–5].

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[1] Grey & Garrett (195). [2] Cuttack, 21–10–37; BRC. 12–6–38 (97). [3] Journals & letters, 1838–40, DLR. 46. [4] Mohan Lal (iii, ix). [5] Fitzgerald, d. Dec. 1831 ; Trevelyan, Asst. to Resdt. Delhi, 1830–1 ; Govr. Madras, 1859–60 ; *DNB.*; m. sister of 1st. Lord Macaulay (*DIB.*). [6] *JASB.*, III, 1834 (9–18 ; 76–9), letters from Kandahār, 10–10–33 ; Jalalābād, 3–12–33 ; Mohan Lal (148, 337). [7] now Dep. Sec., Pol. Dept. [8] *Ben. Dir. & GR.*, 1833–40 (1853 ; 1855), *Indian Mail*, 1848 (423).

On Wade's recdn. he was then appd. Native Agent in Kābul, but the only traces found of his after-life are communications to ASB., in 1836 from Dera Ghāzi Khan, and in 1837, an account of Kālābāgh, made "during our voyage on the Indus[1]", obviously with Burnes [278, 426].

MOHSIN HUSAIN, Syed Mir [III, 485].
Instrument Repairer.
b. Arcot, Madras. d. 11–2–64.

1824, appd. Inst. repairer, SGO., Calcutta; Sub-Asst. GTS. 3–10–36; Math. Inst. Maker, 26–9–43.

"Of good family, connected with the Nawab of Arcot[2]".

After 1830 Everest found Mohsin Husain particularly useful in petty repairs and adjustments to new insts. and base-line apparatus, besides reconstruction of old insts.; he had already learned to take astr. obsns. at SGO. obsy. but was still drawing but Rs. 25 pm. [126].

When SG's office left Calcutta, Dec. 1832, Mohsin Husain accd. Everest to Saugor and Agra, joining fd. office at Garmucktesar; set up fd. workshop at Hāthipaon; now drawing Rs. 90 pm. [3, 129, 172].

In recdg. him for appt. as Sub-Asst. in 1836, Everest reports him as "peculiarly remarkable for his inventive talent, the facility with which he comprehends all mechanical arrangements, and the readiness with which he enters into all the new ideas of others. Without the valuable aid...rendered to me, it would...have been utterly out of my power to carry into effect my various projects for the remodelment of the instruments ...

"It is to Mir Mohsin that I am indebted for the completion [in 1832] of the apparatus for comparing the chains and standard bars. ... The 18-inch theodolites by Cary... both required to be remodelled [142–3]. ... When indeed Mr. Barrow found that my plan was prospering, ... he offered to take the completion...in hand, on which, when they were ready, I found his name engraved, without any mention of the native artist, although he had no share whatever in the design, which was mine throughout, or in the construction of any of the parts which were new, and then first practically applied by Mir Mohsin. ...

"It is to the native artist I am mainly indebted for having been able to introduce my reverberatory lamps into practical use [88, 125]. There was some radical defect in the original, ... which he remedied effectually, after every other person had utterly failed. He understands...all the instruments, ... and I entrust to him to take the largest, most complicated, and most delicate parts entirely to pieces with the utmost confidence. He repairs watches and clocks, the machinery of which he is quite master of [130, 146–7, 165]. ...

"[He] has both genius and originality; his conduct is marked by the highest probity, and...he is one of the few... on whose word I could place entire reliance[3]" [141].

The crowning triumph was his successful division of the horizontal circles of the two astr. insts. during 1839, a task which Barrow had firmly refused to touch. Mohsin devised the special apparatus necessary, and Everest now pressed on Govt. his fitness to fill the post of Math. Inst. Maker vacated by Barrow [6, 98–9, 134–5, 404–5, 418, 436].

"He has been present at the measurement of 3 bases, and at most of the operations of the Great Arc [55, 99, 124]. ... He performed the duty of mathematical instrument maker on all these occasions subsequent to 1832. Whenever any portion of the complicated base-line apparatus was deranged, he put it to rights. When the large theodolite by Troughton was found at first trial unfit for work, he put it to rights [141]. ...

"When the cranes, through the...unskilfulness of the executive department were unavailable for...raising the large theodolites to the summits of the observing towers he constructed others [83]. ... I have not to record one instance of reluctance to undertake, or failure in effecting, what I have intrusted to his management[4]".

Govt. response was not generous; they only allowed, 26–1–42, an increase of salary to Rs. 250 pm., but the Directors awarded him a special honorarium of £200 for dividing the circles which, said Everest, was the least any skilled London craftsman would have accepted. He was to be styled "Head Artificer to the Department of Scientific Instruments [124–5, 135]".

Everest thought the new designation unworthy, and would be "a source of deep mortification to him", and in their letter of 26–9–43, the Directors approved his succession to the title of Mathematical Instrument Maker. In 1854, he was granted a personal allce. of Rs. 150 pm.[5] [131].

He here signs as Seid Mohsin:

Seid Mohsin
&c
Mathl Inst. Maker

MORLAND, Henry [III, 487]. Mad. Inf.
b. 4–10–03. d. 23–12–68.

Ens. 13–2–21 ... Maj. 9–11–46; inv. 17–3–48;
ret. 6–1–53; Hon. Lt Col. 28–11–54.

Son of James Morland, coal merch. of Deptford.

m., Calcutta, 30–6–40, Georgina, dau. of Chas. Rooke, of Brighton; his dau., Bella, m. John Peach Holdich, RNR., and d. 9–12–1934.

1828, joined Hdbd. svy. as Asst. Survr., assuming ch. from 1–8–29.

June to Sept. 1831, leave to Masulipatam "for the benefit of my health"; Feb. 1832, leave for one year to Cape, resuming ch. of svy. 7–7–36, after a spell with regt. [248, 255–7, 344, 361].

At Bangalore, ctml. 16–9–35, convicted of "aiding and abetting the death of a young Ensign" shot in a duel. Guilty of manslaughter—sentenced to imprisonment for 6 mo,—but recdd. to mercy. Sentence remitted; released from arrest, and returned to duty, 10–10–35[6].

April 1837, recalled to unit from Jālna, "proceeding on service to Mangalore"; after release from mil. duty during June, "took leave at Bangalore till end of August[7].

Oct. 1838, on mc. to Secunderābād and Madras, and from July 1839 to sea, writing from Penang, 4–1–40; married at Calcutta June 1840, resuming ch. of svy. at Jālna, Sept.

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[1] *JASB.* v, 1836 (635–8); vii, 1838 (25). [2] Report, 1836 (166). [3] ib. (166–76). [4] DDn. 402 (82–95), 24–7–40 (10, 11). [5] cd. to B., 26–9–43 (35); DDn. 401 (312–7). [6] *As J.* xix, 1836; *Intell* (296). [7] DDn. 432 (175), 22–5–38.

5-2-41, DSG. reports that Morland was having trouble with sub-assts. [381-2], was "sadly annoyed by the Nizam's people, and would gladly...take employment elsewhere". These troubles passed and a dau. was b. at Jālna in July.

March 1843, 3 mo. sick leave to Mahābaleshwar, and again in 1844 to Nīlgiri Hills; had trouble with his eyes [257]. SG. reports, 15-1-49, that Morland was "an able officer, but of sickly constitution, and for a considerable...time...was absent on sick leave. In January 1848, Major Morland was removed from the Department in consequence of promotion to a regimental majority[1]" [368].

NASH, Alexander. Bo. Engrs.
bapt. 16-11-15.
d. Farnham, Surrey, 16-6-47.

Ens. 14-12-32; Lieut. 7-10-40; furl. Jan. 1847.

Son of Alexander Nash, once Comdr. of an Indiaman, and later distiller of Whitechapel, and Helen Campbell his wife.

ed. Addiscombe. Conolly (106/103).

8-11-36, appd. Asst. Rev. Survr. in Deccan, [230, 239, 366] and on Wingate taking furl., 11-11-41, succ. as Supt. Rev. Svy. and Assmt. till relieved by Goldsmid, Jan. 1847. Govt. found his admn. extravagant in that he extended svy. far beyond the immediate needs of rev. assmts. [240, 367].

NELSON, Horatio Ralph [III, 489-90].
Asst. Rev. Survr., uncov.
b., England, 17/8-10-1788.
d. Dehra Dūn, 13-2-39.

Asst. Rev. Survr., 27-11-22.

Son of Alexander Nelson; d. unm. and intestate, with nearest heir in England, and next-of-kin in India, Henry Edward Hunter, indigo planter, Ghāzipur[2]; cousin to Wm. Thompson Dodsworth [390].

Hodson, IV (575).

1807-13, served in RN., rising to mdpn.; 1808, survd. harbour at Hué, Indo-China; Java expn., recd. cut on chin at capture of Samanass; disch. 13-8-13; ht. 5′ 4½″.

There was yet another sailor Horatio Nelson, Lieut. IN. 1846, who d., Bombay, 1859.

Arrd. India before 1818, and employed on svy. in N. Konkan; 11-8-18, appd. Ens. 2nd Rampura Local Batt.[3] till disbandment, 1821.

27-11-21, appd. Asst. Rev. Survr. on Rs. 250 pm. [392]; emp. on Sahaswān svy. till Sept. 1824, when called to mil. service, Arakan, where he comdd. gunboat *Dragon* on svy.—1825-6, with rev. svy. Delhi till ordered, 3-2-27, for svy. Arakan; reaching Calcutta had appt. cancelled [III, 154, 158, 490]—rejoined rev. svy. in Upper *doāb* under Wm. Brown, holding ch. *khasrah* dett. from 1833, when pay was increased to Rs. 362-8 [215, 387-8, 392].

Feb. 1834 took leave on mc. after serious errors had been found in *khasrah*, Brown explaining that "after Mr. Nelson's having so long continued in this Survey to my satisfaction, it would be a gross injustice...to say the above errors arise from indifference or carelessness, much less incapacity. ... Sudden fits of illness, attended for some time with deprivation of sense, ... has apparently afflicted him. ... He has suffered much from headaches, ... much aggravated by the calculations". He was back at work in May and resumed ch. of the *khasrah* svy. in Muzaffarnagar[4].

1834, an unsuccessful candidate for Gen. Ventura's sister-in-law, Anna, who would have brought him a comfortable dowry[5].

1837, Reported again for overlooking serious errors in the *khasrah* svy. under his ch. in Rohtak Dist., pointed out by civil rev. staff. DSG. recdd. reduction of pay, but Rev. Bd. ordered dismissal against which Bedford strongly protested [230]; "The humiliation which anyone who has through life moved in the sphere of a gentleman must suffer from, even the proposed reduction and censure it conveys, requires to be noticed".

He challenged also the right of the Board to interfere with the internal management of the dept. under his direction, but the NWP. Govt. supported the Bd. and Nelson was dismissed, 18-9-37.

Under letter 23-1-38, the Rev. Bd. authorized Nelson's re-empt. under Brown's immediate supervision on Rs. 200 pm., Brown having pleaded that "Mr. Nelson has long been known to bear a high character in society in India, ... in the Royal Navy, and in the service of Government, and his advanced period of life [49 y.], with a constitution much injured by disease, presents him as worthy of compassionate consideration. ... The punishment he has now undergone will ever induce him to be more careful in future[6]".

In Oct. 1838, Govt. refused to forward his appn. for pension; he had served only 16¼ years, against the 20 that qualified. Brown had testified as to Nelson's "bodily and mental infirmity—no longer fit for any employment whatever—much respected by his many friends—proposes to reside at Meerut". He died four mo. later.

NORTH, Charles Frederick. Bo. Engrs.
b. 7-12-15. d. 22-11-1906.

Ens. 11-6-33 ... Col. 14-4-63; ret. as M Gen. 24-10-64.

Son of Charles North, of HM. 50th Ft.

Conolly (106/105).

1839, with Edw. Sanders, survd. route Kandahār to Herāt [282, 284, 405]; of another route Holdich writes "Lieut. North's excellent traverse and report of the route to Kandahar, which still supplies data for an integral part of our maps, was distinguished for more accuracy of detail and observations than most efforts of similar character made at that time[7]".

OMMANNEY, Edward Lacon [III, 492-3].
Ben. Engrs.
b. 2-10-10. d. 3-11-96.

2/Lt. 13-12-27 ... Col. 18-2-61;
ret. as M Gen. 1-9-63.

Son of Edw. Symonds Ommanney, merch. of Yarmouth and Henrietta Maria his wife, dau. of Sir Edm. Lacon, 1st Bart.

m., Dacca, 2-10-32, Elizabeth, dau. of J. W. Martin, Asst. Surg.; their eld. son, b. Cherrapunji, 24-8-34, was given his father's names; BSC. 1852; Col. 1885[8].

ed. Addiscombe, 1825-7. *JASB.*, XIX, 1850; Conolly (88/158); Hodson, III (430).

Dec. 1829, to March 1830, with Gilmore on svy. of road, Burdwān to Patna [III, 28].

1-10-30, appd. asst. to Wilcox on svy. of lower Brahmaputra, taking ch. from Sept. 1831 [III, 16; IV, 10, 265, 351, 360]. Dec. 1834 when short of Dacca directed to close down[9] [266-7], and appd., 7-1-35, 2nd Asst. GTS. [368].

After 2 mo. at Dehra joined Budhon series at Agra 13-6-35, taking ch. from Macdonald in Sept., and by early 1837 had completed obsns. up to Chambal R. [63 4, 154, 355, 455]. Applied to resign in order to complete maps of Brahmaputra svy. as called for under standing rules [II, 286 ; III, 201], but Everest pointed out that the river svy. could not compare in importance with the princl. trgn. of the GTS. ;

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[1] DDn. 462 (265-307), 15-1-47 (71). [2] DDn. Mgte., Wm. Brown to Young, 14-2-39. [3] Rāmpura, Indore, 40 m. E. of Nimach. [4] Brown to DSG., 18-12-33/19-1-34; NWP. Rev. Bd., 18/21-2-34 (1, 23). [5] *Indian Arch.* I, Jan. 1947 (19-20). [6] from Brown, 31-11-37; NWP. Rev. Bd. 23-1-38 (9). [7] Holdich (411). [8] *Who was Who, 1897–1915.* [9] BMC. 2-12-34; DDn. 285 (153).

"Granting that your work [on the river] has been executed in a superior style, and that you are justly proud of it, still it would be but secondary, even if the station points were all fixed, determinate, and enduring. But...they are not so, but...are perpetually liable to be...washed away, ... or destroyed by decay. ... You have been engaged in tracing the course of a wandering stream which varies from year to year, so that ten, or even 5, years hence, not only will no vestige remain of your station points, but the river itself... will in no wise be represented by your data[1]".

Everest had, however, never been satisfied with Ommanney's work, and was glad to forward his resgn., which was accepted under BGO., 1 5 37. Ommanney's real trouble was that he had not yet been promoted 1st Asst. though holding ch. of an independent series. Like many others who failed to please Everest, he had a very successful career on other duties, mainly in the PWD [355].

1846, demarcating new Nepāl Champāran boundary ; *JASB.* XIX, 1850 (136), article on Patna boulders.

OUTRAM, James. Bo. Inf.

b. 29-1-03. d., Pau, France, 11–3–63 ;
bur. Westminster Abbey.

Ens. 1819 ... Lt.-Gen. 1858.

Son of Benjamin Outram (1764 1805) civ. engr., and Margaret his wife, dau. of James Anderson, of Mounie, Aberdeen, and sis. of Geo. Sligo [300, 420 n.2].

ed. Marischal Coll., Aberdeen.

1st Bart. 1858 ; CB. 1843 ; GCB. 1857.

DNB. ; *DIB.* ; Vigne, I (23–4) ; Davidson (108 9) Pankridge (31) ; Sandes, I (286 7).

1830 6, on pol. duty, Gujarāt ; control of Bhīls ; PA. Mahi Kāntha ; celebrated big-game hunter [445].

1839, on pol. and mil. service in Afghānistān ; "carried despatches in Afghan disguise...to Bombay by Sonmiani Bandar route ; MRIO. 115 (31), svy. of route Kalāt to Sonmiāni.

Had distinguished civ. and mil. career, including relief of Lucknow, and closing as Mil. Member of GG.'s Council, 1858–60.

PATTENSON, Thomas Francis. Ben. Inf.

bapt. 9 11 11. d. of wounds,
Kandahār, 26–3–42 ; MI. Afghān ch., Colāba.

Ens. 18 6–29 ; Lieut. 7–3 37.

Son of Charles Pattenson, BCS., and Elizabeth his wife, dau. of S. Harris of Comilla, Bengal.

Hodson, III (477 8).

Afghān War ; on duty with PA. Kandahār from 30–5–40 ; on svy. Helmand R. under Fraser-Tytler [472]. During mutiny of Jan-Baz Horse, 26–12–41, "whilst walking over the field towards morning after the engagement, ... severely stabbed...by one of the wounded enemy" [284].

PEMBERTON, James Jeremiah. Asst. Rev. Survr. ;
uncov.

b. England or Ireland, 1801/2.
d., Darjeeling, 21 4–60, aged 58.

Son of a clergyman. No connection found with Rev. Jeremy Pemberton of Trumpington Hall, Cambridge, and Rector of Foxearth, Suffolk, 1810 39, and not named in *Pemberton Pedigrees.* There was a family of Pemberton's in Wigan, Lancashire, and another in Ireland.

Henry Lawrence claimed him as schoolfellow. There were no Pemberton's at Foyle Coll. Londonderry, where Lawrence was ed. 1815–9, so it is probable that he met Pemberton at Gough's Academy, No. 2 Coll. Green, Bristol, 1819 20 [435][2].

m., Allahābād, 16 10–38, Arabella Eliza, dau. of sub-condr. John Beatson, wid. of Daniel Iben Permien, schoolmaster. One of their sons, James Stuart, b. 8–7–43, joined rev. svy. 6–10 60.

"From family misfortunes" enlisted in a Br. Inf. regt.[3], and was serving as private at Bombay in 1835, when Lawrence obtained his disch., and brought him into his svy. party at Farrukhābād, 1 6 35, @ Rs. 50 pm. ; his advance was rapid, and he was promoted Asst. Rev. Survr. @ Rs. 250 from 1 6–38 [390, 392].

1836, accd. Lawrence to Gorakhpur (E), and 1838 to Allahābād ; 1839, with Stephen to Bundelkhand ; 1840, with Abbott to Benares, and 1841 to Gaya with Stephen.

From 1845 held ch. of party, No. 1 or N. Div., from Purnea to Rangpur and Dinājpur till death.

PEYTON, John [III, 494 5]. Civ. Asst. GTS. ; uncov.
b. in India, c. 3–6–04.

Sub-Asst. 1–10–23 ... Dep. Compr. 18–1–32 ; Prepl. Sub-Asst. 1844 ; Ch. Civ. Asst. 18–5 48 ; ret. 10 4–56.

2nd son of Wynne Peyton, Sup. Surg., Mad. Med.; yr. bro. to James (1800 84), of Nizām's mil. est. from 16–2 20, d. Ootacamund, 6 1–84, whose son James junr. joined Hdbd. Svy. 1–8–47.

1823–5, under Everest on Gt. Arc, Berār to Sironj [III, 380] ; 1825–32, under Olliver on Calcutta Longl. Series, Sironj to Calcutta [58 n.3, 351–2, 370].

Nov. Dec. 1831, asstd. on Calcutta base-line [49–50] ; 18–1–32, the day that base-line was finished, appd. Dep. Compr., remaining with Olliver till close of longl. series [50, 151, 379 80].

c. 24–12–32, left Calcutta with Everest, making svy. of his route Mirzāpur to Saugor with sub-assts. under instn., and "from Saugor via Sipri, Pahargurh and the Lewar Ghāt of the Chumbal to Futtehpore Sikri" [24–5, 271, 434]. ... From Oct. 1833 "preparing and sketching the ground for the measurement of the base-line in the Dehra Dhoon, and fixing stations in the Sewalic and sub-Himalayan ranges" [35, 37, 51][4].

With Everest "in 1834, ... employed in a mountain survey of the Himalayas as far as the snowy range [38, 435], and in assisting in the measurement of the...base" [52].

On Gt. Arc during fd. seasons 1836 to 1840, asstg. in meast. of Sironj base and obsns. for zenith distance[5] [53 n.2, 100, 409].

Held ch. of Gt. Arc comps., both at Hāthipaon and in fd., under Everest's direct supervision, steadily gaining his confidence [108, 110, 165–6, 324, 326, 338 9, 371]. He writes in 1836 ; "Mr. Peyton accompanied me into the field as a volunteer, and I cannot speak too highly of him. In his capacity of computer his patience and assiduity are such as are rarely equalled. .. He has made himself thoroughly master of all formulæ, ... is a very good practical observer, and...possesses a thorough knowledge of all that has been done in the department."[1].

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[1] DDn. 371 (49–51), 12–3–37.
[2] cf. *Indian Officers.* II (101).
[3] pr. 2nd Queen's, Colaba 1832–6.
[4] Built Clover Lodge nr. The Park at Mussoorie [439–40].
[5] DDn. 403 (432), Peyton to SG., 22–7–41 ; DDn. 643 (5), SG. to Mil. Dept., 10–1–56.

1841, pay increased to Rs. 400 pm. [377] and from 1844 held independent ch. of fd. units : 1856, ret. with SG.'s warmest appreciation, with intention of settling in England. Wrote for the newspapers, and painted landscapes and portraits [442 n.7, *inf.* n 3, 473].

PHILLIPS, Joseph Scott. Ben. Art.

b. 24–9–12. d. 18–12–84.

2/Lt. 9–6–31 ... Capt. 10–3–49 ; ret. 24–3–55 ; Hon. Maj. 11–5–55.

Son of Thomas Phillips, prof. of painting at Royal Academy (*DNB.*), and Elizabeth Fraser his wife.

m., Milford, Hants, 30–3–43, Anne Maria, dau. of Wm. Reynolds, and wid. of Thos. Baillie-Hamilton, Bo. Cav.

ed. Addiscombe, 1830–1.

30–11–36, appd. Asst. Rev. Survr. in ch. Tipperah rev. svy., holding ch. till granted furl. on mc., 18–2–41. From March 1844, to regtl. duty ; from 1845 with Ordnance Dept [178, 168, 347, 364, 368, 395].

POTTINGER, Eldred. Bo. Art.

b. 12–8–11. d., Hongkong, 15–11–43.

2/Lt. 13–12–27 ... Bt. Maj. 23–7–39.

Son of Thomas Pottinger of Kilmore, Ireland, and neph. of Sir Henry [II, 437–8] and Wm. [*inf*] ; had two yr. bros. on Bo. Est., both d. 1841–3.

ed. Addiscombe. CB.

DNB. ; *DIB.* ; *Bo Cal. & Alm.* 1841 (323) ; Holdich (402) ; Davis (28–9) ; Kaye's *History of the War in Afghanistan*, 1851 ; portrait, Colesworthy Grant.

1837–8, on pol. mission to Kābul and Herāt in disguise. Led defence of Herāt during 9 mo. siege by Persians.

Later to Kohistān, N. of Kābul, till upheaval of 1841. Took pol. ch. of evacuation of British army, but detained in Kābul as hostage till released by Pollock, 1842.

1840, submitted sketch map of Afghānistān, MRIO. 111(4), shewing his marches in company with Dr. Ritchie of Bo. Med., and other routes [283, 464].

d., at Govt. Ho. Hongkong on visit to his uncle Henry the Govr.

POTTINGER, William. HM. 6th. Ft.

d. 16–5–76. (1st Warwicks).

Ens. 15–12–17 ... Lt.-Col. 2–5–45.

Son of LtCol. Eldred Curwen Pottinger (d. 1814) and Ann his wife, dau. of Robt. Gordon of co. Down and HM. 6th Ft.; yst. bro. of Henry Pottinger [II, 437–8], and uncle to Eldred [*sup*].

1832, asst. with mission to Sind under Sir Henry Pottinger ; compiled map of Sind from routes survd. by himself and De l'Hoste [244, 296, 430].

RADHANATH SICKDHAR[2]. Compr. & Sub-Asst. GTS.

b. Oct. 1813, at Sikdarpara, Jorasanko, Calcutta.

d. 17–5–70, at Gondalpara, dist. Hooghly.

Compr. SGO., 20–12–31 ; SAS. 3rd cl. GTS., 7–5–32 ; Ch. Compr. 31–3–45 ; ret. 15–3–62.

Son of Titu Ram Sikdar, Bengali Brāhman, and eld. bro. to Srinath, appd. compr. 25–1–38.

Kedarnath, son of Srinath, and nephew to Radhanath, d. Nov. 1936, leaving several sons, eld. named Jyotsena Nath Sikdar, and a yr. sister, whose eld. son, S. N. Mukerji, was in 1917 enrolled as attorney of High Court, Calcutta.

Radhanath never married, but his bro.'s family hold various heirlooms, including photo. of a portrait in oils[3], the original having perished. Reproduction from this photo. will appear in vol. V.

ed., 1st., at sch. of Feringhee Kamal Bose, at 48 Chitpore rd. ; 1824, adm. to Hindu Coll.,[4] 9th cl., rising to 1st cl. by 1832. Studied English under Henry De Rozario and Dr. Mollis—maths. under Dr. Tytler[5].

Elected member of RAS., 1853.

Bio. notes by J. C. Bagal[6], *Modern Rev.* 1933, April (457–60) and Sept. (291–2) ; *Prabasi*, Aug. Sept., 1932 ; *Desh*, IV, 21–11–1936—all Calcutta pubns. an ms. auto-biog. was extant in 1935.

20–12–31, appd. Compr. on Rs. 30 pm., with 6 other students of Hindu Coll. [338–9] 6 mo. later appd. Sub-Asst. GTS., on Rs. 107, having already attracted Everest's attention [371][7].

Leaving Calcutta 15–10–32, accd. Waugh and Renny on journey via Mirzāpur to Amarkantak *en route* to join approx. series, Gt. Arc [271, 372, 473]. From Agra, being reported as "young and unformed in character" [372], joined SG.'s office in Mussoorie, and took fd. with Everest in Oct. 1833. Made himself useful on approx. series across Jumna valley, taking his turn with the blue lights with considerable success [27, 30][8].

For the next 5 years worked direct under Peyton or Everest in fd. and recess on the Gt. Arc [44, 52, 53 n.2, 80 n, 108, 373]. Everest described him in 1835 as "a hardy, energetic young man" who "received an exceedingly good elementary education in mathematics at the Hindoo College, which...he has...had the good sense considerably to extend. ... The habits he has acquired...have made him hale, active, energetic, and enterprising [viii].

"His knowledge of English is fundamental, and his pronunciation free from vicious accent, to the extent that it would require a delicate ear to detect any foreignness. He has the wisdom to distinguish the solid worth of the English character from the weeds and lichens which disfigure it, and, carefully avoiding our vices and absurdities, has confined himself to closely imitating our regard for truth, integrity, and manly virtue"[9].

Under normal rules promoted SAS. 2nd. cl. @ Rs. 140, and from 7–5–38 to 1st cl. @ Rs. 173. This latter promotion was further raised by Rs. 100 pm. from 1–6–38 as special increase to retain his services. Most of the other comprs. had resd. to take up posts as Dep. Collrs. in Rev. Dept., and Radhanath had been offered post as sch. teacher. Everest was seriously alarmed at prospect of losing him, for "he was become, as it were, my right arm in all matters connected with computation and registry of data, and the loss of his services at this critical moment would be one of the most severe privations that could be inflicted on me[10]" [341–2, 375, 404, 402].

Discarding the normal inhibitions of a Brāhman, he eventually become thoroughly European in outlook. He writes, "when I started for the Himalayas I took with me a Brahmin cook who died 3 years after. Up to this time I was a rigid Hindu, but after 15 days being my own cook, I began to take English food. Col. Everest was at first dissatisfied but afterwards admitted me in his own table", and later notes that "although by birth of the sacerdotal order, he is by persuasion a Unitarian"[1] [340, 401, 441].

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[1] DDn. 578 (17), SG. to Mil. Dept. 10–1–56. [2] Spelling from autograph. [3] possibly by John Peyton [442]. [4] then the Anglo-Indian Coll. [5] Henry Louis Vivian De Rozario ; *Ben. Dir. & AR.*, 1835 (508). Dr. John Tytler, Ben. Med. ; Surg., 5–10–25. [6] who has given leave to quote. [7] DDn. 567 (170), 1–5–51. [8] DDn. 321 (113–4), 29–1–34. [9] Report 1836 (164). [10] DDn. 348 (207–8), 2–5–38.

Amongst the possessions now held by the family is a copy of Everest's 1847 *Account of...Two Sections of the Meridional Arc of India*, on the title-page of which is inscribed: "Babu Radhanath—Presented by the Court of Directors of the East India Company, in acknowledgement of his active participation in the survey" [110].

There is also a letter from Everest to his father, dated Dehra Dūn, 3-7-40; "Srijuth Tituram Sikdar, Mahasai; My dear Sir, your son Radanath Sikdar has applied to me for leave to proceed to Meerut to meet you, and I have consented though, in truth, he can be but ill spared at the present moment as...he is one of the persons whose aid is most important. I wish I could have persuaded you to come to Dehra Dun. ... Perhaps you will yet be induced to come, having already journeyed so far on your way to the holy Badrinath, which is visible from my house in the hills, together with the whole range of the mighty Himalaya [134, 440]"[2].

1843, with the rest of the SG's fd. office, Radhanath moved from Dehra to Calcutta, arrg. during Nov. [379 n.2]. After Everest's departure he was equally trusted by Waugh, the new SG., amongst his most important contributions to the dept. being the preparation of the first edn. of the *Aux. Tables*.

Contrary, however, to suggestions made, he had nothing to do with the compns. which determined the position and height of the highest mountain of the world, now known as Mount Everest. Official records clearly show that these comps. were carried out at Dehra Dūn, after Radhanath's transfer to Calcutta in 1849 to hold ch. of the comp. office there. The story belongs to another volume.

REES, Vincent Louis [III, 496]. Compr. & Sub-Asst.
b. Berne, Switzerland, *c.* 30-11-1794.

Compr. 15-1-25; SAS. 21-1-25; leave to Europe on mc. 1831-2; ch. sco. obsy. 10-1-35; leave to Mauritius 1849-50; ret. on pension 9-10-52.

m., 1st. Calcutta, 2-6-25, Sophia, dau. of the late J. B. Plusker.

m., 2nd., Calcutta, 24-2-38, Eliza, dau. of the late James Jones, of Ireland; she d. before May, 1850.

Father of W. Palmer Rees, who m., Calcutta, 29-9-54, Miss Mary Ann Mallock. Nothing known of connection with V. Rees, asst. to Messrs. Carr, Tagore & Co., Brokers, Calcutta, who d. 1845, aged 34 y.; 3-7-47, a nephew was preparing for svy. exmn.; 30-9-52, J. S. Rees, pr. son or neph., empd. at Dacca Coll., NOT recdd. for ch. obsy[3].

Arrd. India 1821, and employed as tutor of maths. Developed *chorea*, with partial paralysis of face. Said to have lost Rs. 40,000 by failure of Messrs. Palmer & Co. [III, 471, 495].

Feb. 1831, granted leave to visit Switzerland "to be absent for two years, or such less time as may be sufficient to re-establish perfectly his health, and to draw during his absence one third of his salary, the remaining two thirds being paid to a competent substitute, ... it being understood that in case of his demise the allowance will cease"[4].

George Logan was engaged as substitute for 3 y., to provide for possible delay of Rees' return [454]. "Mr. Rees returned, however, within the period of 2 years. ... His health has not, I fear, been restored, in which case...he can be but partially efficient. His expectations, very naturally, are that at the expiration of 3 years he should come into... his full salary, Rs. 300 pm.", the share drawn by Rees up to Feb. 1834 being Rs. 130 only[5] [371, 379-80].

He refused offer of accg. fd. office up country on increased allce., and continued work in the comp. office at Calcutta, helping in the training of the Bengali comprs. and, from 1835, taking full management of daily time-signals [114-5, 339, 439-41, 375, 381, 462].

In 1838, when Radhanath Sickdhar had asked to resign, SG. thought of bringing Rees up country, though he was reluctant to do so [342]. To Everest's great relief, Radhanath agreed to stay and in thanking Rees for his willingness to move he gave permission to dedicate to him a small technical pubn., "if my name can add any credit to the work"[6].

Rees never recovered from his physical disability, nor was he ever granted any increase of pay, which remained @ Rs. 318-8-3 till his rett. He was, however, allowed in 1835 to take up extra work as prof. of maths. at the Hindu Coll. under the Education Dept. on salary Rs. 300 pm[7].

After sanction of pension[8], 30-7-52, handed over obsy. to ch. compr. 9-10-52, and sailed for England 6th Nov.

RENNY (**TAILYOUR**), Thomas. Ben. Engrs.
b. 18-3-12. d. 3-1-85.

2/Lt. 4-11-29 ... Capt. 4-11-48; ret. as Hon. Maj. 1-1-54.

Son of Alexander Renny-Tailyour (1795-1849), of Borrowfield, co. Forfar, who added surname Tailyour to that of Renny in 1806 on his mother's death, and Elizabeth his wife, dau. of Sir Alex. Ramsay, Bart., of Balmain. The family had possessed the Borrowfield estates since 1615, two of the name being amongst the Scotch barons who submitted to Edward I in 1296[9].

Spent most of his early life in France, where his mother lived on account of her health; went to sch. at Tours.

ed. Addiscombe, 1826-9; Chatham, 1829-31.

m., 9-6-47, Isabella Eliza, dau. of Maj. Adam Atkinson of Northumberland; added name Tailyour 16-11-49. Father of H. W. and T. F. B. Renny-Tailyour, both RE., and good cricketers. The latter served with Survey of India 1888-1920.

Conolly (88/170); Hodson, IV (230, 604).

He signs himself before 1849.

Thos. Renny
Captn. Engrs.

Arrd. India 8-3-31 after a few weeks with OS. in Ireland; 23-7-32, appd.—junr. to Waugh—Asst. 2nd. cl. GTS. [3, 114, 353, 473].

Nov. 1832, left Calcutta with Waugh to join Rossenrode's party on Gt. Arc, survg. route via headwaters of Mahānadi and Narbada rivers nr. Amarkantak [121, 270, 354, 473]. Starting svy. at Sherghāti, 23-12-32, they reached Jubbulpore 10-3-33, and joined Rossenrode at Mao, about 80 m. s. of Gwalior [24, 354, 372].

Spent rains at Agra and raised independent parties, Renny being allotted the Amua Merdl. series [4, 67-8, 406-7], to run N. through Bānda, Cawnpore and Lucknow.

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[1] from Radhanath's Diary; DDn. 542 (306), 18-5-52. [2] *Modern Rev.* Sept. 1933 (292). [3] DDn. 472 (113-8); 542 (336). [4] DDn. 266 (48), 6-1-31. [5] DDn. 286 (52-4), 24-8-33. [6] DDn. 348 (207-8), 2-5-38. [7] DDn. 562 (452), 1-5-52. [8] Rs. 104/8, one third of salary. [9] *County Families*, 1864.

Leaving Agra 30–11–33, reached starting point 13–1–34, and after successful season brought his party into recess qrs. at Cawnpore, 1–7–34.

Everest then recdd. Waugh and Renny for promotion to 1st cl., both being "replete with zeal, decision, and energy. Their manners are most courteous and conciliating. ... They are correct observers, have a vast deal of judgement and good sense, are able and tasty draftsmen, and have a marked and decided talent for mathematical knowledge. I conceive it to be a great piece of good fortune that I have been enabled to meet with gentlemen of this stamp[1]". They were both promoted to Rs. 618 from 24–8–34.

After starting his party out again 13–10–34, Renny reported at Dehra Dūn to join in meast. of base-line [52], and rejoined Amua Series early in June between Cawnpore and Lucknow. With Chas. Lane he laid out triangles to N. borders of Oudh, but was not allowed to close them on the foothills within Nepāl border.

During 1836 helped in design and building of Christ Ch. nave and tower in Mussoorie; the chancel and transepts being added in 1853[2].

Made good progress on Amua Series during 1836–7 with building of towers and final obsns. [85, 159–60]. Called away for meast. of base-line at Sironj [53 n.2], rejoining party 1–3–38 for two months. May 1838 called to Dehra Dūn for work on Gt. Arc which was to occupy him the next three seasons [451].

Leaving Amua series under charge of Murphy, took Budhon party S. to Sironj, where, 24–11–38, he found the unfortunate Mulheran in state of insanity [55]. From here he took up re-obsn. of triangles which Everest had obsd. during 1824–5, working S. till he met Waugh about 20 m. N. of Ellichpur [5, 17, 42, 95, 141, 173].

Work on Amua series having now been completed the party was switched to Budhon series after rains, of 1939. After starting them off under Murphy's ch. Renny joined Everest at Kaliāna for obsn. of zenith dist. repeating the programme at Kaliānpur the following season, 1840–1, and taking first two week's obsns. whilst Everest was ill [99–100, 103, 359, 437].

After rains of 1841, marched from Mussoorie to Bīdar to assist in meast. of new base-line [55–6], returning to Dehra 1–4–42, with all fd. work on Gt. Arc successfully concluded. This repeated march back to the hills in the days before railways involved enormous wastage of time and energy, but was essential for restoration of health, furbishing of equipment, and compn. of results in mutual co-operation. The double journey between Dehra and Bīdar was not less than 2,000 miles [42, 173].

Oct. 1842, resumed ch. of Budhon series at Meerut, but called to mil. duty with Army of Reserve, being posted as Fd. Engr. at Ferozepore [357]. On Everest's strong protest was released in time to rejoin Budhon series 10–2–43, and completed obsns of N. section through Morādābād [64]. At end of the rains, on march of party down to Allahābād to start work on Maluncha meridian, inspected Karara Series under Shortrede before being once more called away to mil. duty [466]. Overjoyed to be posted to Gen. Thackwell's Cav. div. in Gwalior, and to serve at the battle of Mahārājpur, 29–12–43[3].

Rejoined party for 2 mo., taking furl. from July 1844. Whilst in England assisted in comparisons of the standard "B" bar and scale [47–8].

Rejoined GTS. Nov. 1847. Appd. Astr. Asst. 1849 and continued a tower of strength to the dept. till he resd. 1–1–54, having succd. to family estates [368]. Throughout his service he had shewn himself a sound practical geodesist. Like Everest and Waugh he was undefeated by difficulties, being at all times ready to overcome them without sacrifice of precision [44, 89, 319, 380].

RICHARDSON, David. Mad Med.

b. 26–12–1796. d. Moulmein 31–1–46.

Asst. Surg. 9–5–23 ... Surg. 20–7–36.

MRCS. 1817.

Jan.–Feb. 1831, under direction of Resdt. at Ava, kept route svy. of journey by road from Ava to Kindat and Manipur frontier [264, 266].

1836–7, being Surg. to Commr. in Tenasserim, survd. route from Moulmein to Mandalay through Karenni [264–5].

1838–39, with Macleod in ch. of mission from Moulmein to Bankok via Chengmai in Upper Siam [264, 455].

1838–46, Asst. Commr. Moulmein.

RIGBY, Henry. Ben. Engrs.

b. 10–5–11. d. 14–9–81.

2/Lt. 12–6–29 ... Col. 12–3–61 ... Gen. 15–8–78.

Son of Joseph Rigby, solicitor of London, and Elizabeth his wife.

m., Staines, 3–6–33, Georgiana Emma, dau. of John Reynolds.

ed. Addiscombe 1818–9.

Conolly (88/169); Hodson, III (657–8).

March 1831, with Western, attd. to GTS., and joined Olliver on Calcutta Longl. Series nr. Burdwān for instn. [352, 471]; Aug. 1831, after "violent attack of dysentery" granted leave to England on mc. and did not rejoin svy. [368]. 1834–5, Asst. to Garr. Engr. Ft. Wm.; constructed lighthouse at False Pt., Orissa 1836 [457].

RIND, James Nathaniel. Ben. Inf.

b. 24–1–1809. kd. in retreat from Kābul, Gandamak, 13–1–42.

Ens. 30–1–26 ... Capt. 23–11–41.

Son of James Nathaniel Rind, Ben. Inf. [I, 481], and Anne his wife; pr. cous. of doctor namesake [404]; yr. bro. to Wm. J. Rind (1806–69), inv. est., Mussoorie.

m., 20–12–27, Mrs. Marian Rose.

10–7–33, as Lieut. in Pioneer Corps writes to SG. from Bhadrāj; "Having experienced very considerable difficulty... in tracing out the line of road from...the Budraj mountain towards the river Jumna [III, pl. 5], partly owing to the steepness of the dells, and partly to the irregularity of the mountains, ...which will not admit of the eye marking points to work on, the progress...must naturally be greatly retarded. ... I...respectfully recommend that a small theodolite, together with a perambulator, be granted for this purpose. ... As you are on the spot, and have...inspected the progress of the work, you will, I have no doubt, state your opinion as to the necessity of...the instruments[4]". This was the extension of the "pioneer road" which formed the N. limit to Everest's Park estate [104–6, 439–40].

4–11–33, appd. offg. Asst. Rev. Survr. Sahaswān; 4–4–34, confirmed; Feb. to June 1834, with Sahāranpur svy. under Brown [214, 219]. Fraser reports from Bareilly, 15–5–35, that "when Lieut. Rind joined me in June last, he appeared to be acquainted with surveying in...theory, [but]...little practice... [except] use of theodolite and compass, and of Capt.

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[1] to Mil. Dept., 15–8–34; DDn. 286 (151).

[2] Rambler (17).

[3] mentioned in dispatches of C-in-C.; GO GG., 4–1–44.

[4] DDn. 284 (350–1).

Wroughton's surveying board [180], which he had been accustomed to use, and managed with neatness and facility. ... Apparently hasty in temper, is not so with natives in reality[1]". Was on independent bdy. svy. during fd. season 1834-5, but rejoined Fraser March 1835, and took ch. of *khasrah* svy.

Dec. 1835, ch. of rev. svy. Gorakhpur (WC.) till recalled to mil. duty Nov. 1838 [215, 225, 368].

RIND, James Nathaniel. Ben. Med.

b. 16-10-1793. d. at sea, 27-4-40.

Asst. Surg. 29-11-14 ; Surg. 5-5-26 ; inv. est. 23-6-36[2].

Bro. of Malcolm MacNeil (1807-63), Ben. Med., and Thos. (1799-1821), Bo. Med. ; pr. nephew of James Nathaniel senr., and therefore 1st cous. of infantry namesake [463].

Crawford's *Roll*, B. 740.

pr. about 1821-2, appd. Supt. Govt. Litho. Press at Calcutta, and "ably filled the situation[3]" till granted 6 mo. leave on mc., March 1840 [312-3].

CD to B., 28-7-43 (12) his allces. had been "very large owing to his peculiar position as the introducer of lithography into India".

RITCHIE, David. Bo. Med.

b. 19-7-09. d. 28-5-66.

Asst. Surg. 11-8-31 ... Surg. 21-1-46 ... DIG. 6-4-62 ; ret. 1-4-66.

MRIO. 113 (30), route svys. in Afghānistān with Eldred Pottinger, who compiled map [283, 401]. Griffith acknowledges his help with bot. coll. describing him as "the companion of the justly celebrated Major Pottinger during his return from Herat via Jhomunna...also...between Peshbolak and Peshawur. ... Dr. Ritchie is acquainted with route surveying. In this and his knowledge of botany he possesses two valuable requisites of a traveller[4]".

RIVERS, Harry. Bo. Engrs.

b. Cape Town, 4-12-21. d. 4-12-88.

2/Lt. 2-6-39 ... Col. 24-10-64 ; ret. as M.-Gen. 14-4-65.

Son of Harry Rivers, Civ. Commr., Twellendam, Cape Town, SA., and Charlotte Johanna dau. of P. L. Cloeté and wid. of Col. R. Campbell.

ed. Addiscombe. Conolly (106/115).

10-6-42, on Jacob's recdn. appd. by GG in C. in anticipation of Bombay orders, 2nd Asst. GTS. ; joined at Poona from Dhārwār, 9-8-42 [74, 359-60, 448].

14-12-42, took ch. of work on Bo. Longl. series, and 9-1-43, assumed final ch. before Jacob's departure ; 2-5-45, promoted 1st Asst. GTS., holding ch. Bo. trgn. till furl. March 1853 [75, 309-10, 368].

ROBERTSON, George Henry. Bo. Inf.

b. Demerara, WI. 1-1-13.

d. Aden, 10-1-62.

Capt. 12-4-45 ... Bt. Col. 20-4-59 ; Brig.

Son of James Robertson, Registrar of slaves, Demerara, and Maria Catharine Johanna, his wife.

CB. ; ADC., 1859. ob., *The Times*, 21-2-62.

23-11-37, appd. Asst. Rev. Survr., Deccan ; Oct. 1840, to rejoin mil. unit for active service [236, 366-7, 369].

1841-2, with Le Messurier on svy. Kalāt to Sonmiāni [284].

ROBERTSON, James Court. Ben. Inf.

b. 15-9-11.

Ens. 18-7-32 ; Lieut. 3-10-40 ; furl. on mc., 22-4-41 ; name removed, 8-12-41[5].

Son of Harry Robertson, ch. clerk of Ballot Office, Trin Ho., and Julia his wife, wid. of Chas. Pennick.

MRIO. 73 (19), svy. of route, Raipur to Sambalpur 1839-40.

RYVES, Thomas James. Mad. Inf.

b. 17-7-05. d. 1-3-75.

Ens. 8-1-26 ... Capt. 29-9-37 ; inv. 1-6-47 ; ret. 1-5-49.

Son of Lt. Col. Peter Thomas Ryves.

m., 1st., Wallajābād, 31-3-28 ; Julia Louisa, yt. dau. of R. H. Colebrooke, SG. [I : 320-9 ; II, 386] ; she d. of sunstroke nr. Allahabād, 9-6-57, aged 45 y. 17 d.

m., 2nd., Allahābād, 31-3-60, Georgiana, Eliza dau. of Capt. Griffin, Mad. Eur.

MGO. 7-7-40, appd. asst. on Hdbd. svy., holding ch. till relieved by Morland at Jālna 28-9-40 [256].

Nov. 1840, to ch. Nellore svy. ; MMC. 29-10-42, ordered to rejoin mil. unit., handed over 28-2-43 [255, 362, 368].

Nov. 1847, Madras, having wife and 8 children, found insolvent for Rs. 52,000 ; awarded one year's imprisonment.

SAGE, William. Ben. Inf.

b. 7-2-1793. d. 25-5-64.

Ens. 13-12-09 ... M Gen. 13-3-59.

Son of John and Elizabeth Sage.

m. Hannah who d. 11-11-65 ; bro.-in-law of Wm. Seller. Hodson, IV (2-3) ; Pankridge (49).

1829-36, Ex. Offr. PWD., Dinapore and Benares.

MRIO. 19 (30) ; 59 (30-1), maps of coal dists. in Palāmau with geol. sections.

SALE, Thomas Henry. Ben. Engrs.

b. 8-12-14. d. 13-12-1903.

2/Lt. 10-12-30 ... Lt Col. 27-8-58 ; ret. as Hon. Col. 23-8-59.

Son of Richard Cowlishaw Sale of London, solicitor, and Elizabeth his wife, dau. of Geo. Wye, of Oporto, Portugal.

m., London, 7-9-48, Maria, dau. of G. Ravenhill, of Manchester.

ed. Westminster, 1823-9 ; Addiscombe, 1829-30 ; Chatham, 1831.

Conolly (88/177) ; Hodson, IV (5) ; *OW.*, II [815].

1832, with S & M. Delhi ; 1834, Shekhāwati expn. ; 1834-5, survd. Agra and Muttra cants.

23-11-37 to June 1839, on Sylhet-Assam rd. ; svy. of road from Sylhet over Khāsi Hills via Jaintia to Gauhāti, MRIO. 177 (8-107) [264].

SANDERS, Arthur. Ben. Inf.

b. 9-8-12. d. 19-3-95.

Ens. 10-12-30 ... Lt Col. 29-5-57 ; ret. as M Gen. 31-12-61.

Son of Thomas Sanders, Comdr. EIC. Mar, and Rosetta Fortunata Valle his wife ; bro. to Edward [405].

ed. Addiscombe, 1829-30 ; Hodson, IV (13).

Afghān War, Army of Indus, Sept. 1838 to April 1839, offg. DAQMG.

BGC. 22-4-40 (2) ; to ch. Litho. Press, salary Rs. 100, after death of Dr. Rind, but attd. with drawing branch to SGO. ; 1845, DSG. reports that "lithographic press is distinct from this office, and under charge of Captain A. Sanders, of the Quarter Master General's Department[6]" [313].

June 1846, takes ch. of SGO. and MIM. Dept. during absence of DSG. for one month ; 1847 still in ch. Press.

DQMG. at Presdcy., Calcutta, 1852-8.

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[1] NWP. Rev. Bd., 8-9-35 (40).
[2] *Ben. Dir. & A.R.* 1835 (218).
[3] BGC., 17-6-40 (15).
[4] Griffith (xxix).
[5] BGO., 23-2-42.
[6] DDn. 458 (173), 1-12-45.

SANDERS, Edward. Ben. Engrs.

b. 19-1-01. kd. in action, 29-12-43, Mahārājpur, Gwalior.

Ens. 18-5-21 ... Maj. 28-8-41 ; Bt. Lt Col. 12-9-43.

bro. to Arthur [404].

Conolly (86/122) ; Hodson, IV (13-4).

CB.

1834-5, Shekhāwati expn.

Afghān War, 1838-42, with Chas. North of Bo. Engrs., survd. route Kandahār to Herāt, 1839 [282, 459] ; asstd. Griffith collecting plants, but colln. "was nearly entirely destroyed in crossing one of the rivers[1]" [447].

1842 till death, Dep. Mil. Sec., Mil. Dept.

SHAKESPEAR, Richmond Campbell. Ben. Art.

b. in India, 11-5-12.

d. Indore, 29-10-61 ; ML.

2/Lt. 12-6-28 ... Lt Col. 27-8-58 ; Bt. Col. 28-11-54.

Son of John Talbot Shakespear, BCS., and Emily his wife, dau. of Richmond Thackeray (1781-1816), BCS., father of the novelist.

m., Agra, 5-3-44, Marion Sophia, dau. of G. P. Thompson, BCS.

ed. Charterhouse 1823-6 ; Addiscombe, 1827-8.

Kt., 21-8-41 ; CB., 1860.

DNB. ; *DIB.* ; Hodson, IV (60-1) ; *Ben. P. & P.*, VI (297-317), with portrait ; Colesworthy Grant, portrait ; auth. of *A Journey from Herat to Orenburg.*

Jan. 1837, appd. Asst. Rev. Survr. with Fordyce's party, Gorakhpur (W) ; Aug. to Oct., leave to Calcutta, extended to 3rd Nov. owing to "unusually protracted voyage of the steamer. ... The average of the voyages from Calcutta to Allahabad is generally... 21 days...which would have enabled me to reach my destination by the 1st prox.[2]" [170, 362, 368].

Sept. 1838, applied to rejoin his mil. corps ; with Army of Indus arrd. Kandahār, 28-4-39 ; with James Abbott and D'Arcy Todd, making svys., arrd. Herāt 1-8-39. Writes Sept. 1839 ; "You will be surprised after the disgust I have shown for surveying in all its branches, to hear that I have undertaken the survey of the valley of Heraut [453 n.7]. ...

"23rd. Sept. The people of the valley look upon me as a harmless maniac, who has a curious habit of dragging a chain about the country, looking through a "doorbine", as they are pleased to call the theolodite. ...

"16th Nov. We have a pleasant party here, with comfortable quarters, and...hog-hunting close at hand. The climate is delicious, and I have...sufficient employment, so that the exchange from the Revenue Survey of Hindoostan is decidedly in my favour. ... The surveying has made me acquainted with the valley and the natives, and.. enabled me to pick up the language without much trouble[3]".

Dec. 1839, with James Abbott on pol. mission via Kābul to negotiate release of Russian prisoners from Khiva, carrying despatches, and reaching England 1841 ; knighted on arrival [283]. Returned to Bombay 11-10-41, via Suez.

d. of brochitis whilst AGG. Central India.

SHERWILL, Walter Stanhope

b. 31-8-15 d. 20-3-90

Ens. 11-6-33 ... Maj. 2-4-59 ; ret. as Hon. Lt Col. 31-12-61.

Son of Markham Eeles and Lucy Maria Sherwill.

m., Ghāzipur, 24-2-45, Cecilia, dau. of J. M. Hill, Comnr. of Port Elizabeth, SA., ward and sister-in-law of A. C. Heyland, BCS., judge at Ghāzipur.

ed. Addiscombe, 1831-3. Hodson, IV (74).

27-7-38, appd. Asst. Rev. Survr., joining Cawnpore svy. from Hoshangābād ; 10-3-40, leave on mc. to Cape and NSW. till return to Bombay 14-11-41 ; rejoined svy. at Jalaun, and from 13-6-42 to June 1843 held ch. Bihār, or Gaya, svy. in Stephen's absence [184, 349].

From 1844 held ch. S. div. rev. svy. from Shahābād to Birbhum, constructing valuable geol. maps [121, 362, 365-6]. From 1851 Comnr. for readjustment of thāna and local boundaries, and from 1856 Prof. of Svy. at Sibpur in addition [229, 233, 368].

Frequent contributor to *JASB.* ; left many attractive pen and ink sketches of svy. life [III, 345 ; IV, pl. 18].

SHORTREDE[4], Robert [III, 502]. Bo. Inf.

b. 19-7-01. d. 25-11-68.

Ens. 4-1-23 ... Lt Col. 12-10-57 ; ret. as Hon. M Gen. 31-12-61.

Son of Robert Shortreed, sheriff substitute, of Jedburgh, co. Roxburgh ; bro. to Pringle and Wm., both of Ben. Inf. ; and of Mary who m., 1834, Dr. W. S. Memes (467).

ed. Jedburgh gr. sch. and Edinburgh High sch.

m., Allahābād, 19-1-44, Clara Ann, dau. of Geo. Channer.

Auth. of *Logarithmic Tables*, 1844 ; *Traverse Tables*, 1864. ob. notice *RAS.* (*mn*), XXIX (120-1), 12-2-69.

FRAS.

1824, appd. Asst. Survr. Deccan Svy. [III, 126] ; 1828, to ch. trig. svy. Bombay under DSG., Poona [III, 130-1 ; IV, 2, 72, 127, 240, 327, 351, 383].

22-4-31, tr. to control of SG. [14, 56, 344] ; permission to visit SG. at Calcutta refused by Bo. Govr. [358][5]. After searching questions Everest found his work of very poor quality, not in any way conforming to GTS. rules [47, 56-7, 72, 144, 357-8, 448].

Corr. continued for more than two years with growing ill-feeling, which rose to indignation on Everest's part when he found that, from Oct. 1834, Shortrede had been empd. on rev. svy. work for the Bo. Govt., having obtained appt. of Wm. Jacob as asst. for trgn. from Dec. 1833 without notice to SG. [4, 73, 359].

"In 1834...he was appointed to examine...an extensive Revenue Survey and Assessment of the Deccan, in...which it was believed that great frauds had been committed [235-6]. ... Put in civil charge of a district which had long been in disorder, with...power to revise the rates, ... he lowered the assessment, and increased the revenue, and in the course of two years brought 40,000 acres...into cultivation on moderately increasing leases[6]". His report on Pringle's assmt. and svy. led to inauguration of regular svys. under Goldsmid and Wingate [236, 366].

Whilst thus empd. "he had a dangerous illness, and before the end of his sick leave, on the sudden death of the Mint Engineer, he was employed for a few months as assistant in the Mint". Had considerable mechanical skill, and put the transit inst. at Colāba obsy. into working order. "He is himself a workman, and from his former connexion with the Mint...he undertook the re-erection" and "the instrument thus fitted up continues to work satisfactorily[7]".

To Everest's great relief, Shortrede handed over ch. of the trig. svy. to Jacob at the end of 1836, but when Jacob took sick leave two years later he offered to officiate, writing conciliatory letter to Everest; “From the manner in which our connection with each other terminated, you may probably be surprized that I should now write to you. I do so, however, in the belief that there was a misunderstanding between us. Probably you were not aware that my being taken from the survey to other duties was altogether without my request. ... You, supposing that I had been accessory, might very naturally be displeased, while, on the other hand, I was annoyed by your letter, supposing that you wished to get quit of me altogether. ...

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[1] *JASB.* XIII, 1844 (121-34) ; Griffith (xxix). [2] NWP. Rev. Bd., 6-10-37 (30). [3] *Ben P. & P.*, VI (298-317). [4] regular spelling of autog. [III, 126 n.2 , 502]. [5] *GTS.*, XII (iii-5-B) ; (iv-vi-H) ; TS. 8/2 (2-3). [6] *RAS.* (*mn.*), XXIX, 1869 (120-1). [7] ib. VIII, 1848 (52-3) ; 1850 (95).

“I was engaged in an enquiry involving the welfare of a great number of people, and which I felt...I could not leave at a moment’s warning [236]. ... The departure of Lieut. Jacob on sick certificate to the Cape...will leave the Bombay branch...without anyone here who can take immediate direction of it. ...

“You would have no cause to regret such a step, as, besides being familiar with the ordinary duties of the survey, you would find me...tolerably well versed in the...mechanical adjustment and repair of instruments”[1].

Everest consented, after first obtaining from Shortrede a “guarantee...promising solemnly, sincerely, and faithfully, that in all matters relating to the trigonometrical survey I will to the utmost of my ability endeavour to perform my duties in such a way as to meet the approbation of Colonel Everest, by a strict and punctual obedience to his orders”[2].

During the next year Shortrede completed the longl. series to the w. coast, stimulated no doubt by “18 pages of foolscap” containing “remarks by the Surveyor General for the guidance of Capt. R. Shortrede”[3] [74, 239]. On Jacob’s return, 22–5–40, he asked for permanent re-instatement in the GTS., which Everest arranged, being very short of officers [357, 432]. Shortrede joined the SG.’s camp at Kaliānpur about 20th Nov., just in time to take part in the obsns. for zenith distance [100].

From 17th Dec. empd. in neighbourhood of Sironj for about 4 months on minor trgn. which Everest found most unsatisfactory. He had made no effort to compute his work, and left his “angle-book...in the rough state, ...not only not worked up in any wise, but not even in that condition to which it is prescribed that each day’s work shall be brought on its completion in the field”[4] [80].

Whilst at Dehra in 1841 took astr. obsns. for latitude unofficially, and became greatly interested in the problems of Himālayan attraction [105]. Though he stayed with Everest at Hāthipaon—for some days at least—he did not succeed in drawing the great man on the subject[5] [250]. During 1845–9, he wrote to Govt. of I. and read a paper before RAS. which attracted the attention of Sir Geo. Airy, AR. He suggested that Everest had glossed over the implications of the discrepancies revealed in the closing of the Gt. Arc comps., an accusation which Waugh indignantly repudiated as completely foreign to Everest’s character, and amply refuted from the pub. acct. of 1847 [113].

Waugh further pointed out that Shortrede had wasted weeks of good weather in making these unauthorized obsns. instead of getting on with his preparations for the fd., having from 1–9–41 taken over ch. of the Karara Merdl. Series[6].

Marching from Dehra 11th Oct., arrd. Allahābād 17th Dec., having pottered about at various stations *en route*, picking up sundry articles of equipment [69]. Did not commence opns. in Rewah State till the beginning of Feb. 1842, when, finding visibility affected by thick haze, he returned to qrs. at Allahābād before the end of April, having accomplished very little indeed [69–70, 85–6]. It was not yet realized that to take the fd. in these eastern areas before mid-November was courting disaster from “jungle fever”, and Shortrede had every justification for being found still in qrs. at end of October when Everest passed down the river in 1843 [70].

Better progress was made during the next two seasons, though Shortrede again departed from Everest’s principles by laying out his triangles in an amorphous net-work, instead of in a regular chain. In 1844[7] Waugh was so disgusted with the quality of the work and wretched progress that he obtained his transfer back to Bombay, 6–3–45 [368].

With all his talents and good will, Shortrede was somehow incapable of applying himself to regular procedure, and that attention to meticulous detail so essential for geodetic work. Everest writes of him in 1842; “The Captain is beyond doubt a gentleman of reading and research, whose mathematical attainments are highly respectable, but I must in candour avow that I never met with a geodesist so unpractical[8]” [91–2, 435].

Like many other survrs. of keen intelligence, Shortrede was greatly intrigued by problems outside those of his immediate responsibilities [258]. He had been working on his monumental logarithm tables for some years, and had during 1841 and 1842 contributed to ASB. a succession of technical papers on mathl. and astr. subjects[9]. In 1843 he sent to Calcutta “two pieces of a slab of stone from the neighbourhood of Rewah...[that] may be found useful for lithographic purposes”. These were found “rather too soft”, though “a fine-grained sandstone [313]”.

He raised an interesting corr. with Proby Cautley, the distinguished canal engr., writing 13–9–42; “Having read in the public papers...the Report of the Committee on the Ganges Canal projected by you, it has occurred to me that a circumstance...may seriously affect the ultimate stability of the great aqueduct. ...

“Within the last 20 or 25 years, the whole of our northern and north-western frontier, from Nepal to the Indus, has been visited by earthquakes, and I believe they are not uncommon at Mussoorie and Dehra, which are not far from the site of the proposed aqueduct. ... The mere fact...seems enough to warrant great caution.

“It is impossible to say beforehand what would be the precise effect of an earthquake on an aqueduct. ... Some damage to the arches might be expected if they were empty, and if filled with water...some of them might give way. ... The only way of avoiding this danger seems to be to have no extensive aqueduct, but to carry the line entirely on land. I make this suggestion with much respect[10]”.

Cautley passed the letter to Everest, commenting that “this is a point deserving of consideration for, altho’ an experience of 17 years passed in this part of India gives me no instance...of buildings having either been shattered or cracked by a visitation of this sort, still the probability... deserves every attention. ... The aqueduct is 624 feet long and the width and depth of water which will pass through it are 150 and 10 ft. respectively; 22¾ ft. from the bed of the river[11]”.

Even if he had experienced the Quetta earthquake of 1937 and that of Bihār of 1934, Everest would probably have been optimistic; “The objections...to your proposed aqueduct for the Solani valley are...of general applicability. ... Showers of meteoric stones, thunderstorms, hurricanes, waterspouts, and earthquakes, are the modes in which these visitations chiefly exhibit themselves, and...the most probable chance of escaping their effects consists in abiding entirely by the natural surface of the earth.

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[1] DDn. 324 (217–9), 26–10–38. [2] DDn. 343 (3), 14–12–38. [3] *IO Cat.* (24). [4] DDn. 431 (120–3), 16–4–41. [5] Everest had long given deep thought to Himālayan Attraction [68, 104–5]. [6] DDn. 452 (277–97), SG. to Mil. Dept., 28–7–45. [7] after report from Renny [403]. [8] DDn. 402 (371–86), 15–8–42; para 30. [9] *JASB.*, VII (167); X (595–12), (713–5); XI (23–48, 207–11, 776–81, 951–62); XII (103–9). [10] Shortrede to Cautley, 13–9–42; DDn. 405 (95–6). [11] ib. (94), 20–9–42.

"But the Romans do not seem to have been deterred by... these elements of danger from constructing aqueducts of great extent, and...even Portugal and Naples, the very foci of earthquakes, have not been deemed incapacitated thereby. As to what may be stored up in the womb of time, ... what has happened may doubtless happen again, and as there are manifest proofs of mighty catastrophes having...taken effect in this planet, so it is a fair supposition that we are perpetually liable to a recurrence. ... In fact, in the midst of life we are in death.

"Thirty-six years and upwards have elapsed since I first came to India, and I have witnessed several earthquakes, but all so slight as to leave in my mind no cause to apprehend any evil to a structure so solid and substantial as...the aqueduct over the Solani valley is likely to be. I have felt earthquakes in Java and in Naples, compared to which those in India are not to be mentioned. ... As facts are of more importance than opinions, I have to trouble you with an extract of a work...bearing on this subject, and if you will refer to the severe trial which the great earthquake at Lisbon must have given to the aqueduct at Alcantara, I dare say you will cease to have any misgivings"[1].

We have found no record of Shortrede's early work on his Logarithm Tables, "probably the most extensive and correct ever published by a private indvidual without a subscription list".

The 1st edn. was pub. in Edinburgh with title-page; "Logarithm Tables, To seven places of decimals,/containing/Logarithms to Numbers from 1 to 120,/Numbers to Logarithms from ·0 to 1·00000, Logarithmic Sines and Tangents to every/second of the circle/ with arguments in Space and Time,/and. New Astronomical and Geodesical Tables./By Robert Shortrede, F.R.A.S. &c./Captain R.E.I.C.S. and First Assistant of the Great Trigonometrical Survey of India. /Edinburgh;/Adam & Charles Black, Booksellers to the Queen;/London; John Murray, Bookseller to the Board of Admiralty; and/W. H. Allen & Co. Booksellers to the Hon. the East India Company./Andrew Shortrede, Printer./MDCCCXLIV".

The preface was written by John S. Memes, LL.D., his bro.-in-law, of the Manse of Hamilton, May 1844, in default of his bro. Andrew the printer, who was "on the eve of setting out for China. ... To the completion of the work nine years of assiduous labour and study have been devoted. The pecuniary expenses already incurred exceed two thousand pounds, and more will be required before the undertaking can be successfully brought to a close. These sacrifices of time and money have been made entirely at the individual cost of Captain Shortrede, and from no other motive than the love of science".

The 2nd. edn., in two small vols. about 10 by 7 inches, was printed at the Univ. Press, Edinburgh, in 1849, and the preface is sd. by Shortrede, London, Feb. 1849; "A small edition...was published in 1844, before I had an opportunity of seeing it complete. ... In the present edition many alterations have been made, ... and for the convenience of purchasers it is now published in two separate volumes".

In a review of this 2nd. edn. it is recorded that "the composition and stereotyping of [the 1st. edn.]...were executed at Edinburgh, and a small edition was issued in 1844 in one volume while the author was yet in India. Some defects of execution having appeared, Capt. Shortrede, on return to England, caused most of these copies to be cancelled, and after a thorough revision of the plates, and a recast of some of them, he returned to India last year, leaving directions that the trigonometrical part...should be published separately. The part...contains the logarithmic sines and tangents for every second throughout the quadrant, comprised in less than one third of the bulk of Mr. Michæl Taylor's [III, 183]. ...

"Captain Shortrede's tables, though completed at press several months since, have only recently been obtainable in London. The author has fixed a price...barely equivalent to the paper and press work"[2].

1849, returned to his regt. in India, and appd. in Feb. 1851 to Punjab Rev. Svy., where he remained till 1856, when he accd. his batt., 2nd Bo. Eur., to mil. service in Persia.

In 1912 his son presented to the Survey—now in Museum, Dehra Dūn—Shortrede's straight-edge, made with his own hands, and used by him for many years. It is of glass, 50 in. long, supported on corks in its original teak case.

SIDDONS, Henry. Ben. Engrs.
bapt. 9–8–12. d. 26–2–50.

2/Lt. 11–12–29 ... Capt. 1–5–49; Bt. Maj. 7–6–49; furl. 10–9–49, on mc.

Son of Henry Siddons, eld. child of Sarah Siddons of the Theatre Royal, *DNB*.[3], and Harriet his wife, dau. of Chas. Murray (1754–1821), actor, *DNB*.

ed. Addiscombe 1828–9; Chatham 1830.

m., Calcutta, 7–7–34, Harriet Emma, dau. of his uncle, Geo. John Siddons, BCS., PMG., Bengal; Harriet's sister m. Horace Hayman Wilson (1786–1860) [III, 312 n.7].

Conolly (88/173); Hodson, IV (91).

BTC. 13–10–34 (29), appd. Rev. Survr. Chittagong, @ Rs. 618 pm. [8, 178, 193–6, 207–9, 347, 364–5, 448].

1837, made tidal obsns. at Chittagong for July and Oct.[4]; "Those for Jan. [1838] which he had intended also to take in the Tek Naaf, he discontinued on finding that...Harbour Master had been directed to do the same thing by the Marine Board[5]" [119].

Appn., 28–9–38, for tr. to active mil. service was refused; 9–9–39, handed over to E. R. Boileau, making visits to Manipur and Calcutta till 13th Dec.; 13–10–40, again handed over ch., and resd. appt. in Calcutta, 24th Oct., taking furl. 8–2–41 to 11–10–42, not returning to svy. [368, 403].

SIMMONDS, John Henry [III, 503]. Ben. Inf.
b. 1790. d. 7–5–69.

Ens. 6–11–08 ... Maj. 5–10–42; inv. 2–5–45; ret. 12–10–46; Hon. Lt-Col. 28–11–54.

Son of John and Catherine Simmonds, of co. Kildare.

m., Calcutta, 15–2–38, Elizabeth Susannah, dau. of Sir Robt. Graham, Bart., of Esk, Cumberland.

Hodson, IV (93).

Dec. 1823, Asst. Rev. Survr., Delhi, assuming ch. from Oliver 1–10–29 [214, 340, 362, 387].

1832, objection taken to his working in the hills during hot weather and rains, whilst holding office at Sabāthu, and enquiry made as to "what degree the Survey in the hills has interfered with the...Survey in the plains. Whether any expense to Government has been incurred in consequence of his employment in the hills, and whether Captain Simmonds has drawn any allowances to which he would not have been entitled if not employed on field duty. His Lordship in Council has not been pleased to comply with Captain Simmonds' request that the Political Agent at Subathoo be instructed to pay his audited bills[6]".

He managed, however, to move office to Simla during rains of 1833, supported by request of Commr. of Delhi for "survey of certain Hill Purgunnahs under the Political Agent at

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[1] DDn. 406 (277–8), 27–9–42. [2] *RAS.* (*mn.*), X(95), 8–2–50; copies of both Taylor's of 1792 and Shortrede's *Tables* with GBO. Comp.; excellent condition 1957. [3] the survr. was g. son, NOT son, of the actress as stated on p. 8 [viii]. [4] NOT 1835 as shown on p. 119. [5] *JASB.*, VII, 1837 (379). [6] BTC., 12–8–33 (26).

Soobathoo". but again "His Lordship in Council" was firm, and ruled that "Captain Simmonds is not to be allowed to draw the field allowance of his appointment from the date on which he left his duty in the plains, viz., about the 16th April last. ... The Hill Survey is not deemed necessary [215, 452][1]".

Simmonds was now directed to move with his party to take up rev. svy. of Azamgarh Dist. Here he found himself working for James Thomason [471], who as Collr. was intensely anxious to speed up the svy., and was disgusted at the deliberate nature of Simmonds' plans. The DSG. was equally conscious of the slow progress, and found Simmonds particularly difficult to deal with [223 4, 303, 443, 452].

From Feb. 1835, found more congenial work as Sec. to the Clothing Bd., with which dept. he served for the next ten years [368].

SMYTH, Ralph. Ben. Art.
b. 27-8-12 d. 7-2-86.

2/Lt. 12-12-28 ... Capt. 19-8-46; Bt. Maj. 20-6-54; ret. as Hon. Lt.Col. 20-5-58.

Son of Capt. Ralph Smyth, 7th Dragoon Gds., and Amelia St. George, his wife, dau. of Rev. Thos. Adderley Browne.

m., 1st., Dinapore, 29-4-34, Ann, dau. of James Gibbon, indigo planter; she d., Ootacamund, 15-10-55, aged 41.

m., 2nd., Harriett, dau. of Campbell Cameron.

ed. Addiscombe, 1826-9. Hodson, IV (141).

20-11-37, appd. Asst. Rev. Survr. in ch. Central Div., Cuttack, after having "passed a good examination, having solved the greater portion of the problems laid before him" [178, 186-7, 366; pl. 10]. Promoted to Rev. Survr. on full allces. 1-1-41 [365]. Held ch. till Jan. 1843, when he took furl. May 1843.

22-6-47, took ch. 24-Parganas rev. svy., moving party to Nadia in 1852, and Burdwān 1855, when given special responsibility for settling and marking boundaries thus gaining greatly accelerated output.

30-9-57, granted furl. on mc., handing over to Row 1-10-57 [368].

One of the most capable of the LP. survrs, and in reporting his appt. to ch. of rev. svy. of 24-Parganas in 1847 DSG. reported him as a man "of the most indefatigable powers. He gained much credit in Cuttack, and I am sure he will give great satisfaction. His ingenuity and talent as a draftsman is first rate.

"Neither heat nor swamps nor wild beasts deter [him][2]".

Auth. of "*Statistical & Geographical Report of the 24-Parganas*, Calcutta, 1857; collaborated with Henry Thuillier on *Manual of Surveying for India*, pub. Calcutta, 1851 [208, 304, 471].

SPITTA, Charles Lewis. Ben. Engrs.
b. Dec. 1814.
d., Berhampore, 18-10-46.

2/Lt. 14-6-32 ... Lieut. 4-9-39.

Son of Charles Lewis Spitta, merch. of Camberwell, naturalized 1774; and Mary, his 2nd. wife.

m., Calcutta, 16-8-41, Harriet, dau. of Surg. Fredk. Brett.; she re-m., 1849, Edwin Morton, HM. 9th Ft.

ed. Christ's Hosp.; Addiscombe 1830-2; Chatham 1832-3. Conolly (88/184) Hodson, IV (157-8).

1834, with S & M., Delhi; 1834-5, Shekhāwati expn.

1838-40, actg. Asst. to Supt. of Canals w. of Jumna; MRIO. 169 (18), svy. of Nagina Canal, Rāmganga R., whilst Supt. Morādābād Canal.

STEPHEN, Henry Virtue. Ben. Inf.
b. 1-1-11. d. 21-5-58.

Ens. 26-7-28 ... Capt. 9-8-43; ret. 30-4-51; Hon. Maj. 28-11-54.

Son of John Stephen, ch. clerk, of Chelsea, and Harriet his wife.

Hodson, IV (177).

1836, with 19th NI. on service in Cuttack.

25-11-37, appd. Asst. Rev. Survr. Gorakhpur (E); 1838, with Lawrence to Allahābād and Fatehpur, assuming ch. from Oct. 1838; to Bānda and Hamīrpur, 1839-41, with several mo. in Benares, 1840; to Bihār Dist. Dec. 1841 [178, 215, 226-8, 313, 349, 303, 366, 392, 403, 445].

April 1842, rejoined mil. unit at Sukkur, writing from Ludhiāna, March 1843, "Having received permission to rejoin my appointment in the Survey Department at Behar, ... arrived at Loodhiana, ... propose to proceed by dak from Umballa to Meerut, and from thence to Patna by water[3]". Resumed ch. of svy. at Gaya *c.* 9th June [184, 368].

Dec. 1843, applies for 3 mo. leave to Calcutta, preparatory to furl. which dated 17-3-44 till 1846.

1846-51, on rev svy. Punjab, cis-Sutlej. As trained by Lawrence, put quantity before quality.

Auth. of Handbook to the Maps of India, London, 1856; pub. Wm. H. Allen & Co., 137 pp: an alphabetical gazr. with lats. and longs.

STURT, John Leigh Doyle. Ben. Engrs.
b. 5-12-11. kd. in action, 8-1-42, during retreat from Kābul.

2/Lt. 9-6-31 ... Lieut. 20-5-39.

Son of Thomas Lennox Napier and Jannette Sturt.

m., at Resdcy. Kābul, 9-8-41, Alexandrina, dau. of Gen. Sir Robert Sale, GCB. (1782-1845).

ed. Addiscombe 1829-31; Chatham 1831-2.

Conolly (88/179); Hodson, IV (211-2).

1833, with S & M., Delhi; 1835, svy. of Meerut cant., *Ben Regr.* (282 89).

1836-8, Asst. to Supt. Doāb canals; 1838-9, comdg. co. of S & M. with Army of Indus; 28-8-39, appd. asst. survr. to Durand [282];

July 1840, on svy. N. of Kābul, Griffith meeting him "at Syghan the day he left to prosecute his surveys, which had been interrupted by the Kamard disturbances. Recalled to Syghan in consequence of more serious disturbance[4] [447]".

MRIO. 12 (1, 2), survd, route from Kābul to Bamiān [283-4].

ib., 111 (41). "Section through the present defences of the Bala Hissar, Cabul, shewing the alterations and additions proposed...for its better defence. J. D. Sturt, Cabul, 13-12-39, in H. M. Shah Shuja's service".

Fanny Parks writes of him at Mussoorie, 12-9-38; "Capt. Sturt, who is an excellent draughtsman, promised me a sketch of the Hills ere my departure"; and later; "How often after the death of Captain Sturt, who distinguished himself so highly, did I regret never having received the promised sketches, and concluded they were lost during the diastrous retreat from Cabul.

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[1] BTC., 14-10-33 (45).

[2] DDn. 472 (113-8), 3-7-47; Rev. Bd. LP. 4-7-51; DDn. 562 (146).

[3] DLR. 37/82 (149), 17-3-43.

[4] Griffith (xxvii).

"In 1848 Mr. Hullmandel[1] showed me the work published by Gen. Sale, and told me the lithographs were from sketches by Captain Sturt; that the portfolio was lost during the retreat of the army, but was afterwards discovered and given to Lady Sale. ... In all probability they were from the very sketches he had taken for me[2]".

TASSIN, Jean Baptiste. Dmn. & Printer.

A Frenchman. arrd. Calcutta *c.* 1828;
returned to France *c.* 1841.

Jervis (173) ; *Ben. P. & P.* XI, 80 (98) ; XLI, 81 (69).

"M. Tassin", writes Jervis "of Aix (Bouches du Rhone), France, ... was the naturalist of a French ship sent...to the Eastern seas in search of La Pérouse[3]. The vessel was wrecked in the Malayan Archipelago, and...M. Tassin proceeded, a friendless man, totally destitute, to Singapore, and was there advised to try his fortune in Calcutta.

"Mr. H. T. Prinsep [101 n.6], hearing that he understood lithography, set him up with a loan of 1,000 rupees, and procured for him the execution [printing] of...the surveys of the Hooghly and Ganges rivers by his late brother, Captain Prinsep of the Engineers [III, 15–6, 405–6], and all the Asiatic Society's and Government work. At the end of 9 years M. Tassin assured me that he retired to his native land with £16,000 made by his industry in this line[4]" [313].

His name first appears in *EIR.*, 1830, "List of European Inhabitants", but MRIO. 29 (20) is a reduction of Gerard's Agra Bhopāl svy. [III, 89], beautifully copied by Tassin at SGO. Jan. 1828, and in a letter of 10–6–29, Herbert, actg. SG., obtained Govt. sanction to employ Tassin to litho. a map of Gorakhpur, at fee of Rs. 300 [III, 209].

1832, had "a small establishment at No. 99 Durrumtollah" which he called "the Oriental Lithographic Press" [10].

Besides Prinsep's map above referred to, Tassin pub. lithd. edns. of Wilcox's map of NE. Frontier [III, 64]—a plan of Simla, 1830 [260]—the Salt-Water Lakes, in six sheets, 1831—Map of Calcutta, 1832, [III, 13]—Map of the Post Offices, 1838—Anglo-Persian and Anglo-Hindi maps of India and many others [204, 247, 265 n.10, 267, 293, 304, 311–2]. The last to be pub. under his name, *A New and Improved Map of the Provinces of Bengal and Behar* was issued in 1841 [286, 312][5]. Many of the maps drawn at SGO. were sent to Tassin to be printed in preference to the Govt. Litho. Press [335, 466].

He is referred to in a letter, 24–12–40, from Geogl. Com. [288, 301] regarding map required by the Commr. of Patna, of which they write that "the remaining portion...will...be included in the map which Mr. Tassin is now lithographing of Bengal and Behar[6]". This is the last reference found to Tassin and his Oriental Press, and implies that he was still working at the beginning of 1841, in spite of Jervis's note quoted above.

TAYLOR, Thomas Glanville. Astronomer.

b. Ashburton, Devon, 22–11–04.
d. Southampton, 4–5–48.

Arrd. Madras, 15–9–30 ... left on mc. 15–3–48.

Son of Thomas Taylor, asst. to AR. at Royal Obsy., Greenwich, from 1805/6; had a bro. Rev. Henry Taylor, a Govt. Mad. chpn., 1841–60.

Left widow and 3 sons, one of whom, Henry Hanson, served in GTS. 1862–7.

DNB.; Ob. notice, *RAS.* (*mn*), IX, 1849 (62–3) ; Poggendorff ; *MRAS.*, XII, XVI, Memoir on Longitude of Madras ; ib., X, paper on Halley's comet.

FRS. 1842 ; FRAS.

Early in 1820, engaged as supernumerary at Greenwich obsy., and brought on regular est. of 4 assts.; Aug. 1822, ch. of transit obsns. at night. Asstd. Sabine and Kater on pendulum experiments [III, 254], *Phil Trans.* 1829 (85, 207).

On recdn. of AR. appd. early 1830 to be Company's Astronomer at Madras [III, 191, 321]; assumed ch. obsy. 28–9–30; his work at Madras is embodied in 5 official vols., and results noticed in Baily's Catalogue of Fixed Stars[7] [103, 115].

During 1829 helped Everest with preparation of Gt. Arc book [III, 257], and Everest obtained permission to call on his help with GTS., even on fd. operations. He took advantage of this but once only, writing to Mil. Dept. Jan. 1831 that "Mr. Taylor was, before he left England, practically instructed in the use of the measuring apparatus. ... I therefore...wish to direct Mr. Taylor...to be in Calcutta on or about the 1st October next to aid me in the measurement of the base-line[8]" [115].

In Prinsep's sketch [49–50, 353] 2nd figure from left, at last microscope[9] [pl. 2].

Arrd. Calcutta before end of Sept., and allowed Rs. 350 pm. towards "house-rent and extra charges...during his stay" but did not like the quarters allotted to him at Ft. Wm.; "I applied at the office of the Town Major, and was shown the only quarters now disposable. ... Two very small rooms one apparently intended for a sitting-room and bed-room, the other for a bathing room. ... The quarters...do not correspond with the...letter...that *suitable quarters* were to be provided. ...

"The present arrangements require my attendance *every day* at 6 miles distance, ...and, increasing every day, will towards the end of the measurement amount to 13½ miles to be performed before six o'clock in the morning, and the same distance back again after six o'clock in the evening. ... I respectfully...[request] such allowance...as shall place me on the same footing as when at Madras, and an allowance for travelling on an average twenty miles per day[10]".

Everest strongly supported him: "The quarters...are...in the Rampart Barracks, and as I resided in the Range, so-called, some years ago [III, 353], when they were kept in the best possible condition, I can...assure His Honor in Council that they can by no means be made suitable to the style of living to which Mr. Taylor has been accustomed, or to his station in society. ...

"Should...regulations be deemed an insuperable impediment, ... I submit that it is not inconsistent...for me to include Mr. Taylor's extra expences in the contingent bills[11]".

Govt. replied that "the Town Major and the Barrack Master...both assert that they are the best kind of Captain's quarters in the Fort, and have submitted a plan which does not confirm Mr. Taylor's statement[12]".

Taylor retorted that he was not a mil. offr., and that qrs., allotted to "junior civil servants...are much to be preferred to those...offered to me", and Everest agreed that Captain's qrs. were unsuitable; "Mr. Taylor's father is the 1st Assistant to the Astronomer Royal; has 300 £ a year, with a house, coals, and candles; permission to undertake private computations, and a graduated scale of pension. ...

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[1] Chas. Joseph (1789–1850), Lithographer.
[2] Parks, II (274, 342).
[3] auth. of *Voyage...autour du Monde*; pub. 1797.
[4] Jervis (173).
[5] MRIO., 41 (27).
[6] BRC., 26–1–41 (60).
[7] *JASB.*, II, 1833 (380–2) ; IV, 1835 (258–60).
[8] DDn. 265 (141–2), 26–1–31.
[9] *JASB.*, I, (72).
[10] DDn. 264 (250–2), 8–10–31.
[11] DDn. 265 (259–60), 26–10–31.
[12] DDn. 263 (335–8), 26–10–31.

"Mr. Taylor junior was when I first became acquainted with him residing with his father at the Royal Observatory rooms. He was one of the junior Assistants, for which he received 150 £ per annum. He was also computer to the Board of Longitude for which he received 250 £ per annum, and he was allowed to avail himself of private computations, by which he realized on the average about 100 £ a year. So that he had a clear net income of 500 £ a year. And this was not a precarious tenure, for those who live in England by their own exertions are free from the storms by which men of rank and fortune are agitated.

"His father's house was a snug, comfortable little dwelling, with a neatly furnished drawing-room and parlour, and nice garden, and all those little appliances by which the domestic state of England is so peculiarly distinguished. The father had served in the observatory since the time of Dr. Maskelyne [I : 155 ; II, 258], and was entitled to retire on his full salary as a pension. The son had the promise from Mr. Pond [III, 530] of being recommended to succeed him. ...

"In accepting the situation of Astronomer at Madras, Mr. Taylor was not urged by need, or induced by the unalloyed desire of gain, but by the love of distinction and honourable enthusiasm in his profession, and when he quitted the comfortable fire-side, the family circle, and a settled income, to embark in a strange country, it surely was not too much to expect that the advantages which accrued to him should bear some comparison with those which he relinquished. ...

"No two abodes can well be more dissimilar than the quarters in the Rampart Barracks of Fort William and the dwelling for the Assistant at the Royal Observatory. Besides which, a person who has not been brought up amongst Military Gentlemen does not readily bend himself to their customs, or feel himself at his ease in mingling with them. ... I recommended Mr. Taylor to the notice of the Court of Directors. ... It is surely incumbent on me...to express my opinion without reserve[1]".

We have not found how the matter was settled, but a passage back to Madras was provided for the Astronomer and his 3 servants at the end of Jan. 1832, and Everest did not again make any call for his asstce. in the field.

Taylor took leave to England during 1840–1. "Two or three years afterwards he met with a severe accident while on a visit to the observatory of Trivandrum [Travancore], a fall occasioned by his extreme shortness of sight, from which he never perfectly recovered. His own failing health, and the anxiety he felt with respect to his daughter's illness, who was then in England, brought him back to his native country. He arrived on the 4th of April last [1848]. ... His child... expired next day[2]". He died himself a month later [300].

TERRANNEAU, Robert [III, 507]. Asst. Survr.,
b. Calcutta, 24–12–1790. uncov.
d. Morādābād, 19–11–41.

Asst. Rev. Survr. March 1827 ; Rev. Survr. 4–4–36 ; reverted to Asst. 13–9–37.

Son of Wm. Terranneau, indigo planter, and Elizabeth Mitchell his wife ; g. son of Charles Cossard de Terranneau [I : 388], and bro. to Wm. Henry Terranneau, Ben. Inf., for many years Ex. Offr. PWD. ; making various road svys., 1820–36, round Dacca, Jessore, and Mymensingh : *Ben. Regr.* (7/44, 46).

m., Bareilly, 5–8–27, Elizabeth Addison Browne.

1827 to 1834, Asst. Rev. Survr. N. Morādābād under Birnie Browne ; 1832 asstd. Colvin in lay-out of canals ;[3] reported fit for ch. of svy. [387, 392].

From Nov. 1834, given ch. of new party raised for Azamgarh (E) in preference to Fordyce, in view of "Mr. Terranneau's established claims of general qualification and long service. ... He holds the same rank in the Department as Lieutenant Fordyce, and performs the same duties, with the extra claim of near seven years experience before Lieutt. Fordyce was appointed. ... Although an uncovenanted assistant, he...was originally appointed a full Assistant by Lord Amherst in 1827, and is a gentleman of good education and ability[4]" [214–5, 224–5, 443].

12–3–36, DSG. recdd. Terranneau for promotion to full survr. to fill a vacancy, again in preference to Fordyce, but the Rev. Bd. did not agree ; "Mr. Terranneau does not possess that method and force of character which can justify him to exercise so effective a superintendence, and to furnish the results...with that correctness, regularity, and order, as is essential to the full success. ... Lt. Fordyce, ... does possess these qualities" [363, 443].

The NWP. Govt. accepted Bedford's recdn., and ordered the promotion of Terranneau, as they favoured "the employment of well educated persons in preference to commissioned officers", and wished to encourage the advancement of the uncov. services[5].

At the end of 1836 Terranneau raised a new party for Bānda, leaving his Azamgarh svy. in the hands of James Brind [227, 423]. In June 1837, DSG. called him to explain certain discrepancies in his Azamgarh work, brought to light by checks made by the Collr., James Thomason [471]. Terranneau had to confess that he had allowed the original fdbks. of his svy. to be destroyed, and they alone could have proved his accuracy. He had to carry the blame, and Govt. ruled that "the usual precautions which the system affords have been neglected. The comparison of the svy. maps with each other and with the khasreh maps affords the simplest means for ensuring accuracy [230]. It is to be hoped that the present failure will lead to increased vigilance. ... Mr. Terranneau is unfitted for the charge of a survey. He will revert to his former situation[6]". The Rev. Bd. called attention to their earlier opinion [225, 363].

Aug. 1837 he took leave on mc., on half salary, Rs. 263 pm., on expiry of which, July 1838, he rejoined Browne's party in Morādābād [454 n.2].

19–7–40, Browne submitted appn. from Terranneau for pension, but was told to wait till he had completed the necessary 20 years service. The appn. was resubmitted, claiming—in addition to 14 y. with svy.—service in Java for over a year "when that island was restored to the Dutch [II, 137, 294], and...refused the offer of the continuance of the same high emoluments made by the Dutch Commissioner, in order to re-enter the service of the EIC. at Penang", where he was attd. to the Recorder's court, and "served some time... as Deputy Sherriff".

Govt. found him not entitled ; "The period of his employ as Secretary to the Recorder of Penang as sealer of the Court, and notary public (4 years and 7 days)...is inadmissable. ... Mr. Terranneau has only served the Hon. Company 15 years and 358 days[7]".

The following was the personal description given with appn. for pension. "Son of William Terranneau—Black eyes and hair, and complexion rather dark—height 5 ft. 7 inches—age 23rd Jan. 1841, 50 years, 29 days—Protestant...—Average salary last 5 years Rs. 469–8–3—at time of application, Rs. 362–8–0—defective vision—constitution shattered[8]".

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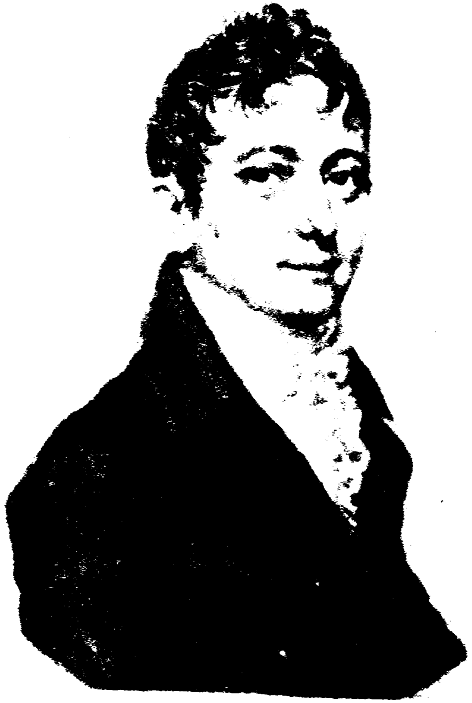
[1] DDn. 265 (298–301), 5–11–31. [2] *R.A.S.* (*mn.*), IX, 1849 (62–4). [3] Col in to Sec. to GG. 1–11–32. [4] from DSG., 1–9–34, BTC., 29–9–34 (94). [5] NWP. Rev. Bd., 25–3–35 (41) & 6–5–36 (23–29) ; the first uncov. Asst. to hold independent ch. [6] NWP. Govt., 13–9–37 ; Rev. Bd. 22–9–37 (88). [7] NWP. Rev. Bd., 29–6–41 (7). [8] ib., 2–2–41 (18).

Henry Thuillier
Revenue Surveyor

HENRY LANDOR THUILLIER

1813-1906

BENGAL ARTILLERY. K.C.S.I.; F.R.S.; REVENUE SURVEYOR, LOWER PROVINCES, FROM 1837; DEPUTY SURVEYOR GENERAL, CALCUTTA, 1847-61; SURVEYOR GENERAL OF INDIA, 1861-77.

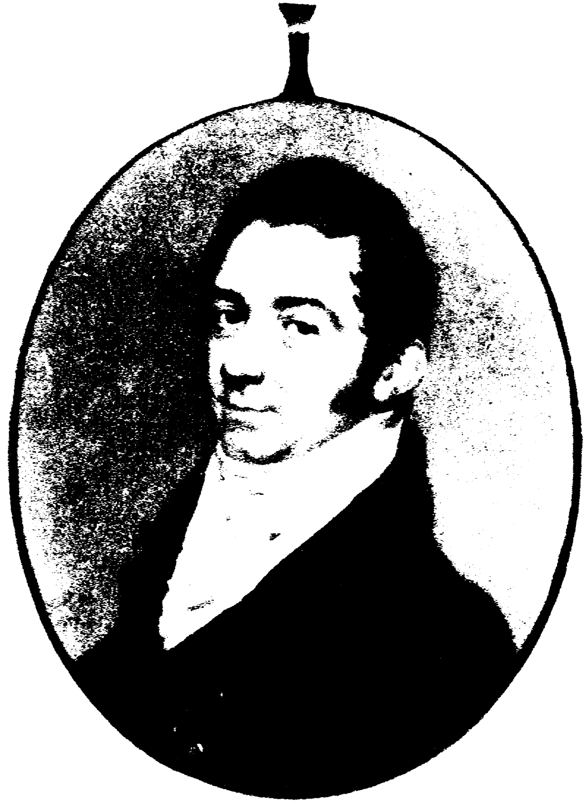


J. Goldingham

JOHN GOLDINGHAM
1765/6-1849

ASTRONOMER, MADRAS OBSERVATORY
1796-1830 [I,387-8, II,402]

FROM A SKETCH BY JOHN SMART,
PROBABLY LONDON, 1808

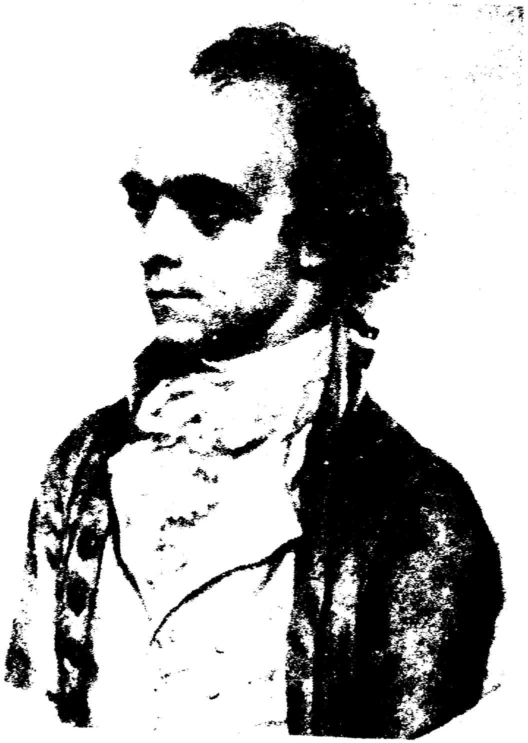


C Reynolds

CHARLES REYNOLDS
1757/8-1819

BOMBAY INFANTRY, LT. GENERAL,
SURVEYOR GENERAL, BOMBAY, 1796-1807
[I,378-80; pl. 20, II,438-9]

FROM A SKETCH BY JOHN SMART,
LONDON 1810.



Michael Topping.

MICHAEL TOPPING
1747-96

ASTRONOMER & SURVEYOR, MADRAS, 1786-96
FOUNDED OBSERVATORY 1792, AND SURVEYING
SCHOOL 1794 [I,389-93]

FROM A SKETCH BY JOHN SMART, MADRAS,
BEFORE APRIL 1795.

THOMASON, James. BCS.
b. 3–5–04. d. Bareilly, 29–9–53.

Writer, 1821; Mgte. & Collr. Azamgarh 1832–7; Sec. to NWP. Govt. 1837–41; Sdr. Rev. Bd. Allahābād. 1840–3; LG. NWP. 1843–53,

Son of Rev. Thomas Truebody Thomason, Ben. chpn. [II, 102, 403, 443].

DNB.; *DIB.*; Muir.; Morris; Temple; Blunt (97,396).

From 18–9–32, Collr. Azamgarh Dist. [286]; 1834, protested strongly against slow progress of Simmonds in conduct of rev. svy., and recdd. 2nd party that was raised by Terrameau [214, 223–5, 230, 468, 470].

With Merttins Bird pressed strongly for increased output from rev. survrs., and helped to bring in new policy of 1837 [7, 217–8; 322, 420–1, 453].

From 2–3–37, offg. Sec. to LG. NWP., Jud. & Rev.; 1839–40, leave to Europe; extra Member of Sdr. Bd. of Rev. from 1840, and Member from 1842 [216, 321].

"About 1843, the Circular Orders of the Board of Revenue, for the broad principles of which we are mainly indebted to R. Merttins Bird, fell out of print, and Thomason issued a new circular, Directions to Settlement Officers", embodied, 1850, in "Directions to Revenue Officers[1]" [102].

The Roorkee Engr. Coll. was proposed in 1846 at suggestion of Proby Cautley [209], and opened on 1–1–48. With the strong support of Thomason, it was in 1854 renamed the Thomason Coll. of Civil Engineering, and greatly enlarged. It now included "a Depot and Workshop for the repair of surveying and other scientific instruments, an observatory, a printing establishment, etc.[2]".

THORNBURY, Nathaniel Henry. Bo. Inf.
b. 23–3–08.
d. at sea, 1–6–81, on voyage to Australia.

Ens. 7–12–24 ... Capt. 4–1–45; Bt. Maj. 11–11–51; ret. 1–1–52; Hon. Lt Col. 28–11–54.

Son of Rev. William Henry Thornbury of Dorchester.

m. three times.

MRIO. 118 (1), undated, but pr. 1842, svy. of road, Belgaum to Dhārwār.

THUILLIER. Henry Edward Landor. Ben. Art.
b. Bath, 10–7–13.
d. Richmond, Surrey, 6–5–1906.

2/Lt. 14–12–32 ... Col. 29–8–65 ... Gen. 1–7–81; Col. Comdt. 1–1–83.

SG. 12–3–61 to 31–12–77.

Yst. of 11 children of John Pierre Thuillier, merch. of Cadiz, Spain, and Bath, Baron de Malapert of France, and Julie his wife, dau. of James Burrow of Exeter.

In letter to Presdcy. Pymr., 16–12–47, disavows name "Edward", signing himself "H. L. Thuillier"; "the signature...of my two Christian names...is the only one I can safely testify or answer for. The third initial...recorded in the Army List has now been appended, although it is not recognized by me[3]".

m., 1st., Calcutta, 21–12–35, Suzanne Elizabeth, dau. of Rev. John Haydon Cardew, rector of Curry Malet, Somerset, sister of Ambrose Cardew (1806–37), Ben. Art., and wid. of Henry Wm. Steer, of Bengal. She d., Calcutta, 7–1–44; they had issue 1 son and 1 dau.

m., 2nd., Calcutta, 8–4–47, Annie Charlotte, dau. of Dr. Geo. Gordon Macpherson, Ben. Med., having issue 6 sons and 2 daus.

Eld. son, Henry Ravenshaw Thuillier (1838–1922), Ben. Engrs.; SG. 1887–95; had son M Gen. Sir H. F., KCB., CMG., DL., of RE., who d. 1953 aged 85 y., and a yr. son Leslie Cardew, b. 1878, ISC., with S of I. 1901–32 [364 n.3, 366].

ed. Addiscombe, 1831–2. CSI. 1870; FRS. 1869; Kt. 1879.

DNB.; *DIB.*; Hodson, IV (273–4); *Who was Who, 1897–1915.* Portraits include 2 oil paintings in uniform by Wm. Beetham, 1845, and one in plain clothes of about the same period (pl. 21); a small tinted photo-etching taken at the age of 64, and a portrait in oils by Mrs. Francis Rowley at the age of 85. There is a very pleasing group photo. taken at retirement of Waugh in Calcutta in 1861, which includes Waugh, Thuillier, J. T. Walker, and Montgomerie[4]. There is a less satisfactory portrait in oils by G. G. Palmer, an engraver of SGO., printed deptly. 1913.

Autn., with Smyth of *Manual of Surveying in India*, 1st edn. Calcutta, 1851 [364, 468].

3–1–37, appd. Asst. Rev. Survr. in "the Jynteeah Territory" annexed to Sylhet from 1835—and, 18–2–37, Dep. Collr. "for special and exclusive duty of deciding boundary disputes" [199–200]; appd. 25–7–39 Rev. Survr. @ Rs. 526 pm. [365, 403; pl. 9].

10–4–40, to ch. Puri rev. svy. till end of rains 1841 [179, 180], when he returned to Sylhet and took svy. into Cāchār [8, 178, 347]. Early in 1842 took up experimental svy. in Sylhet, and in Nov. was tr. to Patna during absence of Maxwell [149, 185, 199–200, 207–8, 296, 366, 457]; 22–2–43, left Patna to return to Sylhet:

"I have this day made over charge of the Patna Revenue Survey to Lieut. Maxwell. ... The arrears of the Cachar & Sylhet surveys are under charge of Mr. Kelso. ... By my transfer I have been a great sufferer, having been put to a great expense in moving, not only my own private property and family, but the records of my former surveys and survey apparatus, and the very short time I have had charge has not even given my family an opportunity of joining me". He asks to return to Sylhet to bring that work to a speedy conclusion[5] [403–4].

He closed Sylhet svy. by end Nov., and sailed from Calcutta 14–2–44, shortly after wife's death. Had shown particular ability in conduct of these svys., introducing notable improvements by adjusting procedure to local conditions [200, 207]. Bedford told Rev. Bd. that he considered Thuillier "the ablest and most efficient of the Bengal Surveyors[6]".

After return from furl. Dec. 1846, became DSG. and Supt. Rev. Svys. holding office at Calcutta till appd. SG. in 1861 [309, 368, 476]. Directed the printing of the first Indian postage stamps on SGO. presses, 1854–5.

TICKELL, Samuel Richard. Ben. Inf.
b. Cuttack, 19–8–11. d. 20–4–75.

Ens. 12–6–29 ... Lt Col. 18–2–63; ret. as Hon. Col. 24–1–65.

Son of Samuel Tickell (1785–1817), Ben. Inf., 1st cousin of Richard (1785–1855), Ben. Engrs. [II, 446].

m., Bānkura, 1–7–44, Maria Georgiana, dau. of J. S. Templer.

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[1] Muir (38). [2] ib. (67); cf. *Statesman*, 22–11–49, celebrating centenary. [3] DDn. 459 (133). [4] will appear in vol. v, with photo. by Melhuish at age *c.*, 60. [5] DLR. 37/60 (179), 6–2–43. [6] DDn. 474 (61), SG. to Thuillier, 18–4–43.

ed. Addiscombe 1827-9. Hodson, iv (276-7).

1832-3, with operations against Kōls and Chuars in Chota Nāgpur : *Ben. Rev.* (10/67), survd. route of 31st NI. "Mullye to Berhampore" ; 1835-6, on svy. in Kōl country ; MRIO. 19 (32), compiled map of Chota Nāgpur ; ib. 38 (12-4), map of Jungle Mehāls, w. of Midnapore [206].

Regular contributor to ASB. ; tribes of Chota Nāgpur and their languages ; collections and notes on natural history[1].

From 1840 on pol. duty, Nepāl, Chota Nāgpur, Arakan, Tenasserim. 1848-9, in ch. Bhāgalpur rev. svy. during Sherwill's absence.

Auth. of *Game Birds and Fishes of India*.

TODD, Elliott D'Arcy. Ben. Art.

b. 28-1-08.

kd. in action, battle of Ferozeshāh, 21-12-45.

2/Lt. 18-12-23 ... Capt. 13-5-42 (local Maj).

Son of Fryer Todd, of Chancery Lane, acct., and Mary Evans his wife.

m., Calcutta, 22-8-42, dau. of Dr. E. L. Sandham, MD., Surg. 16th Lancers.

DNB. : Hodson, iv (284) ; *JRGS.*, viii, 1838 (29-53, 101-8); *Punjab Inscpns.* (344-5).

1833-8, on mil. duty with royal troops in Persia ; with British Envoy to Herāt, 1838 ; Oct. 1838, MS. to Sir Wm. Macnaghten to Kābul ; June 1839, on mission to Herāt, taking Abbott and Edward Sanders [283-4, 410-7, 465].

IO Cat. (487), sketch of road between Tehrān and Astrabād in Persia, 1837 ; *JASB.* xiii (339-60) Report on journey, Herāt to Simla, 1838 ; left Persian camp before Herāt on 22nd May, and arrd. Simla 20th July.

TROWER, Jasper. Ben. Art.

b. 2-5-06. d. 18-12-45, of wounds recd. at battle of Mudki, 1st Sikh War.

2/Lt. 13-10-24 ... Capt. 8-10-43.

Son of George Trower, merch. of London, and Mary his 1st wife, dau. of Geo. G. Stonestreet.

m., Calcutta, 3-7-32, Charlotte, dau. of Geo. Sunboll, of 33rd Ft. ; she m. 2nd., 5-10-50, Octave Delpierre, Sec. to Belgian Legation.

ed. Rugby : Addiscombe 1822-4.

Punjab Inscpns. (350-1). Hodson, iv (313).

1826-34, with H Art., 1834 to 9-1-37, furl. on mc. ; 3-10-37 appd., Asst. Rev. Survr. s. div. Puri, Cuttack [178, 186, 368] ; 8-11-39, being on leave to Dinapore, granted leave on mc. for 12 mo., and raised long discussion on rate of leave salary [364-5].

FRASER-TYTLER, William. Ben. Cav.

b. 12-12-15. d. 12-9-78.

Corn. 9-7-35 ... Bt. Capt. 9-7-50 ; rtd. 10-7-52.

Son of Wm. Fraser-Tytler of Balnain, Inverness, and his wife Margaret Coussans, only dau. of Geo. Grant of Burdsyard, co. Moray. Bro. to Chas. Edw. Fraser-Tytler (1816-81), of BO CS., who was asst. to Goldsmid on rev. svys. and settlements, 1840 [238-40, 420, 445], and to Gen. Jas. Macleod Bannantyne Fraser-Tytler (1821-1914), Ben. Inf.

Afghān War, 1838-42, DAQMG. with Army of Indus ; 1839-40, svys. round Kandahār and in Helmand valley : MRIO. 113(5-7), sketches in Kunār valley from Jalalābād, 1840 ; ib. 116 (30), Kalāt and Ghilzai to Kābul, 8 m. to inch [460].

IO Cat. (480), 1845-7, compiled map of Afghānistān from svys. of mil. campaigns that was embodied in John Walker's map of 1857 [294-5].

After rett. was an enthusiastic Colonel of "Volunteers".

VIGNE, Godfrey Thomas. Traveller & Author.

b. 1-9-01. d. 12-7-63.

Eld. son of Thomas Vigne of Walthamstow.

ed. Harrow, 1817-9. Called to bar, Lincoln's Inn, 1824.

FRGS. ; *DNB.* ; *DIB.* ; Burrill (72). Auth. of *A Personal Narrative of a Visit to Ghazni, Kabul, and Afghanistan*, London, 1840 ; *Travels in Kashmir, Ladak, Iskardo, the Countries adjoining the Mountain Course of the Indus and the Himalaya North of the Panjab*, 2 vols. 1842. Both narratives suffer from lack of dates, but the second contains useful map with new infn. [200]. *JRGS.*, ix, 1839 (512-6).

Left England Oct. 1832 and after visit to Persia sailed from Bushire to reach Bombay about 1st Jan. 1833.

pr. about June 1834, stayed with Gerard's at Sabāthu, meeting James, who had recently got back journey to Bukhāra [274-6, 445]. Visited Simla, and describes sports ground at Annandale, and then to Mussoorie with Lee Warner[2]. Spent a night with Everest on Chaur Peak [435], and found him a few months later measuring base-line nr. Dehra [52]. Visited Tāj at Agra, and then stayed with Wade at Ludhiāna, 1-6-35, to collect permit from Ranjit Singh with which to enter Kashmir, travelling via Nurpur, 16-6-35—Kangra—Chamba—Jammu 4-7-35, reaching Srinagar in August.

He travelled through to the Indus, visiting Ladāk and Skārdo, showed his journeys on a map "laid down on a scale of two miles to the inch, principally from a base of three miles, measured...in the centre of the plain by Lieut. Mackeson [272, 292 n.7] and Dr. Falconer[3]". The map was much appreciated, and a reduction was engraved by John Walker at the expense of the Directors [292][4]. Burnes writes from Kābul, 16-9-41 ; "I look out with great anxiety for your map and book relating to Cashmere and Gilghit, ... by far the most interesting portion of your wanderings, and which will fill up a great blank[5]".

With account of Kashmir gives a detailed list of the passes [261 n.3] and of archaeol. ruins.

His journeys into Afghānistān in 1836 were equally interesting to geographers, and included, writes Holdich, "a venturesome and...successful exploration of the Gomul route from the Indus to Ghazni".

"Vigne was not a professional geographer so much as a botanist and geologist, ... although he has left on record a map of his journey which quite sufficiently illustrates his route". He refers to Vigne's practise as an amateur physician ; "It is always the doctors who make the best way amongst uncivilized peoples[6]".

Sailed from Bombay for England, May 1839.

WAUGH, Andrew Scott. Ben. Engrs.

b. Cannanore, Malabar, 3-2-10.

d. London, 21-2-78.

2/Lt. 13-12-27 ; arrd. India 25-5-29 ... Col. 18-2-61 ; ret. 12-3-61 ; Hon. M Gen. 6-8-61.

SG. & STS. 1843-61 [368].

Son of M Gen. Gilbert Waugh, MAG., Madras, who d., Penang, 3-11-44, and Charlotte his wife, dau. of M Gen. Geo. Wahab, Mad. Est. ; Gilbert Waugh was g. son of Col. Gilbert Waugh of Gracemount, Midlothian, descended from Waugh of Shaw, standard-bearer at Flodden Field.

No confirmation has been found of Markham's statement (p. 83) that Wm. Petrie [II. 265 n.2] and Andrew Scott

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[1] *JASB.* ii, 1833 (569-83) : ix, 1840 (694-710 ; 783-808 ; 997-1007 ; 1063-90). [2] Edw. Lee-Warner (1788-1857) ; BCS. 1804 ; son of C. E. Bagge taking name, 1814, of his mother Anne, dau. of Thos. Lee-Warner. [3] *JRGS.* xi, 1841 (xlix). [4] *IO Cat.*, (225-6). [5] Vigne, i (iii). [6] Holdich (462-9).

[1 : 383] were 1st cousins of Andrew Waugh's father. Petrie's mother Margaret was dau. of Andrew Waugh of Selkirk, and Scott's elder bro. Charles m. Elizabeth, dau. of Wm. Waugh of Shaw.

m., 1st., Calcutta, 8-6-44, Josephine Morison, dau. of Dr. Wm. Graham of Edinburgh ; she d. 1866.

m., 2nd., in England, 1870, Cecilia Eliza Adelaide, dau. of Sir Thos. Whitehead, KCB., Ben. Eur. Fslrs., of Eccleston, Lancs.

ed. Edinburgh High Sch. ; Addiscombe 1827-8, passing out head of term ; Chatham 1828.

Kt. 10-12-60 ; FRS., 1858 ; Gold Medal, ROS., 1857 ; DL. city of London.

DNB. ; *DIB.* ; *RAS.* (*mn*). xxxix (216) ; *RGS. Progs.* xxii (315-7) ; *Addiscombe* (423) ; Hodson, iv (412-3) ; *Geo. Mag.*, v, 1878 (68) ; Markham (424-7) ; *Friend of India*, 7-2-61 ; *Nature*, 6-1-78 ; Conolly [88/154].

The bearded portrait so well known in the Dept. was painted by John Peyton, "the well-known artist of the Department", and was hung in SGO. with ceremony 17-2-86[1] [401]. A more pleasing one appears in a group photographed on his rett. in 1861, and will appear in later volume[2] [471].

1829, with S & M., Aligarh.

1830, offg. Ex. Engr. Allahābād ; 30-10-30, 6 mo. ; leave to PWI. ; 25-6-32, CE. acknowledges his work in "the successful demolition of the roof of St. Peter's Church in Fort William-...[a] dangerous undertaking. ... Through his careful management it has been...concluded without any...untoward disaster, to which I certainly looked with...apprehension and dread[3]".

19-5-32, as Adjt. Engrs. Ft. Wm., applied for appt. GTS., and appd. 2nd Asst. with effect from 2-7-32, staff salary Rs. 250 p.m. [114, 353, 402].

With Renny, deputed in Nov. to join Rossenrode's party for instn. on approx. series of Gt. Arc, ; on journey from Mirzāpur explored country towards headwaters of Son and Narbada, and fixed the far-famed Amarkantak. Their small party which left Calcutta Nov. 1832 included the young Bengali Radhanath Sickdhar [461]. To their full and accurate svy, and notes on the country, Waugh added a knowledgeable geol. report [24, 270-1].

After working with Rossenrode for about 3 mo., they spent rains at Agra, where Waugh raised party for Ranghir Merdl. series [64-5]. Leaving Agra 20-11-33, reached starting point, Ranghir, a few miles SE. of Hatta on 6th Jan., staying out till end of July. Lost nearly 5 mo. testing likely stations on line ordered by SG., and then found suitable line further east which he ran some 100 miles through Hamīrpur Dist. efforts, that won his promotion to 1st Asst. from 24-9-34 [153].

After about 10 weeks recess at Cawnpore, started selection of stations N. wards across the *doāb*, till called to Dehra to assist in meast. of base-line [2, 51]. Did so well that Everest entrusted the repeat meast. to his charge, and obtained his appt., as Astr. Asst. in succession to Wilcox 27-4-35 [39, 112, 356]. Rejoined Ranghir series in May [85].

For season 1835-6 called to the Gt. Arc to assist Everest who had been seriously ill [5, 315, 435]. Joined at Saini, nr. Meerut, 3-1-36, and shared obsn. of the triangles to just S. of the Chambal. Spending rains at Mussoorie, again took the fd. with Everest, and was held up with him for two weeks at Dholpur [40, 155]. Completed obsns. through Gwalior to close with Everest who obsd. N. from Sironj. Then conducted vertical angles across Jumna valley [41, 90, 93, 107] ; spent rains at Hāthipaon, possibly sharing Bachelor's Hall with Jones [440, 451].

Oct. 1837 once again marched S., this time to measure base-line at Sironj [10, 53-4, 310]. After its completion in Jan. 1838 he marched S. to spend rains at Hdbd., being held up 3 weeks at Hingoli with fever [42]. During season 1838-9 re-obsd. Everest's triangles of 1824 N. wards from Damargida nr. Bīdar, to meet Renny working S. from Sironj [95, 157]. They returned together to spend the rains of 1839 at Hāthipaon, and helped to complete the astr. circles [135, 458].

Next two seasons were devoted to astr. obsns. for zenith dist., Waugh obsg. at Kaliānpur 1839-40, and Damargida 1840-1 [17, 97, 99-101]. During 1840 marked out new line for Bīdar base and completed connections with surrounding stations early in 1841[4] [43, 55-6]. Recessed at Secunderābād, drilling his men with Colby measg. apparatus, and made actual meast. nr. Manjra R. between 19th Oct. and 4th Dec. ; returned to Dehra in April 1842, after absence of 2½ years, and final completion of all fd. work on the Gt. Arc. [56, 411, 437].

Season 1842-3 connected N. ends of the Ranghir and Amua series through Pīlībhīt Dist. which, writes Everest, was "altogether about as complete a specimen of rapidity of progress, combined with accuracy of execution, as there is on record. The tarai, or low land, to the north of Rohilkhand and Pilibhit ... is skirted by the bhabar, or forest. ... There is no Dun, or valley, analagous to those of Dehra or Kharda, bounded by a low range to the south[5]" [67, 71].

Oct. 1843 with Everest to Calcutta, where he took over ch. as SG. and STS., 16-12-43 [440].

Throughout these years Waugh had won and held Everest's goodwill, and his work had been repeatedly brought to the notice of Govt. ; Everest had long decided that he was by far the best officer to succeed and carry on the GTS. [44]. He had pressed his recdn the more strongly after the appt. of Jervis as "provisional Surveyor General". He writes in 1836 : "Lieutenant Waugh was originally recommended by me...in 1832, and I have every reason to be proud of my recommendation. He is a gentleman of unbounded zeal and energy ; his talents and attainments are of a superior order. His manners are most courteous, and marked throughout by high-mindedness and independence of sentiment. I barely knew this gentleman personally in the first instance ; ... my opinion of him is therefore, totally unbiassed by considerations of private friendship[6]" [3, 21].

"This officer has been a most inestimable colleague and coadjutator to me. ... I never had the least reason to regret the confidence I have reposed in him, or to find fault with him in any way and...there is probably not another person on earth of whom I would have confided so much, or of whom I could speak so decidedly[7]" [44].

1839, applied for active service at siege of Jodhpur claiming that by his absence at Hdbd. the year before he had lost his chance of serving with the Army of the Indus[8]. Everest killed his hopes of mil. glory ; "If Lieut. Waugh be removed, I shall on no account...commence either the simultaneous observations for celestial amplitude, or the measurement of the base-line near Beder until his return, or until at least I have met with some person equally valuable[9]" [257].

In 1842, after Jervis' rett., Waugh's appn. to succ. as "provisional" SG. and STS was warmly supported by Everest ;

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[1] SGO. Order No. 184, 16-2-86. [2] recd. in 1952 from Miss Cole, dau. of Wm. Hammond Cole, in ch. Comp. Party, 1864-92. [3] DDn. 284 (103). [4] DDn. 378 (172), sketch of vicinity of Bidar, shewing Manjra R. [5] TS. 9/1 (5) and trgn. stns. [6] Report, 1836 (158). [7] DDn. 438 (107) 8-6-37. [8] DDn. 378 (737-9), 15-8-39. [9] DDn. 438 (109), 17-8-39.

"Except Lieut. Renny who is his junior, I know of no one who can at all pretend to rival him[1]". Govt. promised to consider his claims when the time came, and Durand, PS. to GG., added on his own account; "You [Everest] are the best judge of the fit man to carry on your operations". Waugh duly succeeded [11, 318–20, 433, 439].

WESTERN, James Roger. Ben. Engrs.
b. 28-2-12. d. 13-1-71.

2/Lt. 12-12-28 ... Capt. 24-8-47; Bt. Maj. 7-6-49; ret. 23-1-55; Hon. Col. 1856.

Son of James Western, of Bath and London, solicitor, and Charlotte his wife, dau. of Rev. Robt. Hallifax, vicar of Standish, Glos.

m., Calcutta, 25-11-47, Catherine Laura, dau. of Chas. Samuel Goodwyn of Blackheath.

ed. Uppingham 1827; Addiscombe 1827-8; Chatham 1828–30.

Hodson, IV (430-1).

Attracted Everest's attention whilst a young officer at Chatham and travelled to India in same ship, landing Calcutta 6-10-30 [113, 351].

5-1-31, appd. Asst. GTS., on Rs. 250 pm.; with Rigby attd. for training to Calcutta Longl. series under Olliver. May and June, employed to search neighbourhood of Calcutta for suitable spot for meast. of base-line, and took part in meast. on Barrackpore road [48-50, 352-3, 405-6, 463]. In Prinsep's sketch looking through boning telescope on left [pl. 2].

Jan. 1832, given ch. of s. Parasnāth series, the first of the new parties to take fd., leaving Calcutta during Feb. with 2 sub-assts. "Appeared", writes Everest, "to set about his work in a spirited manner. Before he had completed a single triangle...the insurrection of the Coles and Chaurs took place [3, 59, 77, 90-1, 158, 330, 452, 472]. in consequence of which he was ordered to carry the series to the northward".

His work was, however, so full of errors that Everest reluctantly decided that he would never be suitable for the precise work of the GTS., and he was tr., 6-9-34, to S & M. at Delhi [60, 355, 368, 423].

Did useful work later with PWD.

WHEATLEY, Arthur. Ben. Cav.
b. 2-2-07. d. 13-9-81.

Corn. 9-1-24 ... Lt Col. 14-11-53; Bt. Col. 28-11-54 ret. as Hon. M. Gen. 31-1-61.

Son of John Wheatley, barr., Calcutta, and Georgiana his wife, dau. of Wm. Lushington.

m., Mainpuri, 8-11-27, Charlotte, dau. of Goddard Richards (1764-1835), Ben. Inf.

Hodson, IV (437).

1840, made sketch of Seoni, and of route to Amarkantak, "the bearings...taken with a hand-compass and the perambulator[2]" [288].

WHISH George Palmer. Ben. Inf.
b. Fatehgarh, 30-6-13. d. 31-1-1902.

Ens. 19-11-29 ... Gen. 1-10-77.

Son of Gen. Wm. Sampson Whish (1787-1853), Ben. Art. [163, 439], and Mary Dixon his wife.

m., 1st., Mhow, 15-3-36, Maria, dau. of John Tulloch (1790-1862), Ben. Inf.; she d., Calcutta, 4-1-55.

m., 2nd., Benares, 16-3-69, Anne Wemyss, dau. of James Black of Edinburgh, and wid. of W. Wright.

Hodson, IV (442-3).

MRIO. 82 (1-5), 1840; Map of Alwar State from svys. by Bellew and Whish, latter a beginner [273].

1838-9, DAQMG.

WILCOX, Richard [III, 513-5]
b. 31-5-02. d. Cawnpore, 26-10-48.

Lieut. 7-12-19 ... Lt Col. 13-3-45.

Son of Richard Wilcox, woollen draper in the Strand, London, and Jane his wife.

m., Ghāzipur, 29-7-33, Susan Jane, dau. of Geo. Wilson of Ghāzipur; their son, George Henry, Lieut. RN., m. at Dehra, 9-9-61, Julia, dau. of Thos. Haslam.

Hodson, IV (465). *RAS* (*mn*), XI [92-3]; FRAS.

1824, Asst. Rev. Survr., Morādābād [III, 332-3]—Burmese War. 1824-6, on mil. svy. in Assam [III, 54-5, 202, 204]—1826-8, exploring sources of Brahmaputra [III, 55-64, 513-4; IV, 263, 446]—1828-31, on svy. lower Brahmaputra [III, 16, 64; IV, 2, 10, 198, 265, 287, 336, 351, 459].

GR. 1879-80 (43) records that obsns. for longitude made by Wilcox along NE. Frontier were "very closely corroborated by recent operations of G.T.S.".

Sept. 1831, having visited Calcutta on short leave, retained by SG. for base-line meast. In Prinsep's sketch, 3rd figure from left, at microscope [3, 49-50, 352; pl. 2][3].

BMC., 27-2-32. tr. for duty with GTS.; 23-7-32, appd. Astr. Asst. GTS. with view to "the celestial observations connected with the Great Arc"; salary Rs. 600 pm. later amended to Rs. 618 [114, 131, 353].

> Everest reported that "Lieut. Wilcox is a person highly able, and likely to qualify himself in a shorter time than any person in the Department. ... I have long watched...the admirable manner in which he has carried on his detailed survey of the Burrampooter by throwing a series of small triangles across that river, and...there is a style of accuracy and neatness about his operations which I have never seen surpassed. ...
>
> "Since his arrival in Calcutta, I have conversed a great deal with him upon professional subjects, and find that he is a young man of as much intelligence as modesty, and deeply interested in the profession he has engaged in[4]". Herbert describes him as "one of the cleverest young men we have". Strongly recdd. by Everest to succ. Herbert as DSG., but Govt. refused to promote him over Bedford's head [324, 420].

Dec. 1832, accd. SG. from Calcutta, via Mirzāpur, and Saugor, to visit Rossenrode on Gt. Arc, reaching Gwalior about 5-4-33 [152]. Dropped at Muttra with instns. to make good junction of N. and S. sections in that vicinity [4, 25, 129, 434]. Spent rains there preparing for SG.'s return from Mussoorie in Nov., and then deputed to pick up Rossenrode's stations nr. Gwalior, and carry approx. obsns. along E. flank of merdl. series as laid out by Everest [27, 30-1, 139, 159], who writes with impatience of his slow progress [35, 37-8]. Joined Everest in Mussoorie, and asstd. at meast. of base-line in the Dūn [52, 434].

5-2-35, appd. on SG.'s recdn. to succ. as Astronomer to the King of Oudh, in ch. of obsy. at Lucknow [115, 356, 368], Herbert having only made preliminary designs and ordered insts. Assuming duty from Sept. 1835, "made a valuable series of observations with the help of native assistants, but died in October 1848, and in 1849 the King of Oudh abolished the observatory"[1]. The records and insts. were allowed to perish [116-7].

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[1] DDn. 402 (293-5), 16-4-42.

[2] cf. *JASB.*, IX (903).

[3] ib. I (72), 1833.

[4] DDn. 265 (261-91), 12-10-31.

Accounts of his work appear in the pubns. of the RAS. and ASB. [117].

WILSON, William A. [III, 372]. Asst. Rev. Survr.,
b., *c.* 1806. uncov.

1822-30, appce. and sub-asst., 1830-4, dmn. SGO.; 1834-40, asst. rev. survr.; 1841-2, in tempy. ch. from 1844 in ch., Midnapore, Hooghly, 24-Parganas, till 1847.

m., Calcutta, 1st 1833; 2nd 31-8-42, Mrs. Margaret Mitchell; father of Wm. Alex. Wilson, appd. to Rev. Svy. 1861.

ed. at Upper Mil. Orphan Sch., Kidderpore; 1823-6, with RSG. to Fatehgarh [III, 304]; July 1826-30, Gorakhpur, and on break-up of that svy. empd. as dmn. SGO. @ Rs. 60 pm., "a well-disposed young man, and a tolerably good arithmetician" [335-6].

At the end of 1834 tr. to Rev. svy., and posted to Egerton's party in Monghyr [183]; with him to Hijli in 1838, as senr. sub-asst. [189-90]; Oct. 1840, sent from Midnapore, as asst. survr. in ch. to relieve Phillips in Tippera, drawing Rs. 388 pm. [198-9]. On break-up of svys. in Oct. 1842, reverted to Rs. 250 pm., on Midnapore svy. in preference to disch [396].

1-8-44, took over ch. Midnapore rev. svy. from Mathison [395-6]; moved party to Hooghly Dist. in 1845 and 24-Parganas in 1847. After complaints as to quality of svy., Smyth took ch. on return from furl. June, 1847, Wilson being disch. in 1848 [408].

Later re-empd. in rev. svys. CP. and Oudh till 1861.

WINGATE, George. Bo. Engrs.
b. 27-2-12. d. 7-2-79.

Ens. 21-6-29[2] ... Capt. 9-7-47, ret. 15-6-54; Hon. Maj. 28-11-54.

Son of Andrew Wingate, merch. of Glasgow and Margaret Millar his wife.

m., 1843, Agnes dau. of John Mair of Glassgow; she d., 18-10-94, aged 76.

ed. Glasgow Univ., matric. 1825; Addiscombe; Chatham KCSI. 1866. *DIB.*; *Oriental Club.*; Conolly (105/88).

From Dec. 1836, Rev. Survr., Deccan, and Asst. to Prepl. Collr. & Mgte., Poona.

BO RC., 23-1-37, appd. Supt. Rev. Svy. in Deccan, with increase of Rs. 150 pm.; BO RC., 14-5-38, appd. Asst. Collr.; "it is essential to the efficient discharge of his duties as superintending the revenue survey that Lieut. Wingate should...exercise the powers vested in law in revenue officers". From 1841 held joint functions as Supt. of Svy. and of Assmts., with similar powers to those of his civ. colleague Goldsmid [9, 236-7, 239, 242, 366-7, 429, 445, 465].

On his taking furl. 11-11-41, the Rev. Commr., Poona, expressed regret at his departure; "Government have had so many opportunities of learning his manifold qualifications for the task, ... and of appreciating the soundness of judgement, and great tact and perseverance, which are seldom found combined with energy. ... Should the task of carrying on the work prove now to be free from serious difficulties, such... will be mainly attributable to the excellent arrangements of the officer by whom the Department was first organized, and has since been managed[3]" [240, 396, 459].

Returned Bombay 14-11-43, with his wife, by steamer *Cleopatra*, which left Suez 5th Oct., and later appd. Rev. Svy. Comnr.

WOOD, John. Indian Navy.
b. 1811. d. Sind, 13-11-71.

Mdpn. 13-6-27; Lieut. 17-2-33; ret. 8-2-40.

ed. Perth Academy.

DNB. DIB.; Low II (87 *et seq.*); *Bo Geo Soc.*, I (363, 383); Wood (vi-xii), *JRGS.*, XLIII (clvii); Markham (20, 21 n.); Davis (12); *Oriental Club*; Holdich (412-441).

1834-5, survd. Laccadive Is., sailing from Bombay 6-12-34[4].

1835-6, examined Indus R. for steam navn., comdg. steam boat belonging to Persian merch. of Bombay; hoisted British flag on river, 31-10-35. Steamer returned to Bombay in Feb. 1836, Wood remaining to record extent of inundations.

9-11-36, appd. Asst. to Burnes' commercial mission to Kābul sailing from Bombay, 26-11-36 [244]. Mission left Tatta 10th Jan, and spent two weeks at Hdbd., where on a day's sport Burnes shot the bear. Travelling up Indus by country boats Wood was entrusted with the detailed svy. At Kālabāgh flood water made further progress by boat impossible, though Wood was determined to make the attempt whilst his companions travelled by land [278].

He procured a boat and crew with considerable difficulty. "Seven miles above Kalabagh we passed a rocky precipice above the river. ... Next day we arrived at Mukkud, ... twenty miles from Kalabagh. Here the boatmen left us, although I made the most liberal offers to induce them to remain. Believing that Captain Burnes might still be in the neighbourhood of Kalabagh, I felt anxious to communicate with him. ...

"I resolved to be the bearer of my own despatch, and to drop down with the current upon a mussuck, and come back by land the next morning. So, after stripping, and tying a suit of clothes upon my head, I audaciously pushed off from the steep bank, and launched into the stream; but scarcely had I advanced two yards, when, losing my balance, the buoyant skin jumped from under me, and I had to regain the bank as I best could.

"A thousand times had I seen the mussuck used, and...I thought there could not be any great mystery in managing a contrivance so simple that children were permitted its use. ... Like all other *polite* arts, the skill to ride or swim upon a mussuck is not to be acquired without some application. ... After my mishap, the man who was to have been my companion on the river proceeded with the despatch alone. ...

"We left Mukkud on the 27th, and toiled against the stream till sunset. At day-break next morning we were again at the track-ropes; but the most unwearied exertions brought us in the evening no further than...five miles. ... The obstructions...were not in the river's channel, but...the wall-like nature of its banks. ... All hope of being able to advance higher was completely cut off by perpendicular banks several hundred feet high which buttressed the river.

"In the summer, when the Indus is swollen, the voyage is altogether impracticable. ... The great rapidity of the current is...an unsurmountable impediment. ... It is often necessary to cross from one side of the river to the other. ... It is more galling than I can well describe to find your boat, while you are crossing a stream two hundred yards wide, borne away by a sweeping current and, despite the best efforts of her crew, landed below an impending cliff which can only be doubled by re-crossing and working up the bank you have just quitted. Convinced of the utter hopelessness of any further attempt to reach Attock by the river, I now proposed to fulfil the latter part of my instructions, and proceed there by road". Reaching Attock by land, he took boat down river to Kālabāgh, and then marched by road through Kohāt up to Peshāwar, where he rejoined the mission [277-8][5].

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[1] *JASB.*, XVII, 1848 (507); Markham (328); cf. report by Tennant, 1857. [2] rank of 2/Lt. for Bo. Engrs. substituted for Ens. from 1830 [421 n.3]. [3] sd. J. Vibart, 13-10-41; BO RC., 1414/1842 (47-8). [4] *JRGS.* VI, 1836 (29-33). [5] Wood (67-9).

After return from Kābul in 1838 made a more thorough svy. of the river from Attock to Mithankot with[1] map of 5 sheets, scale 2 geo. m. to inch, with remarks on navn., soundings, banks, extent of inundation, and ferries.

Making svy. up the Kābul R. to Jalālābād, and on by road, entered Kābul with the mission on 20–9–37. After some svy. in Kohi-Dāman area N. of Kābul, accd. Lord on adventurous journey to the notorious city of Kunduz in Turkistān [III, 486 ; IV, 425], which they reached in Dec. 1837. Whilst Lord spent winter with his important patient, Wood made remarkable journey and traced the Oxus to its source in the Pamīrs [vii, 279–81 ; pl. 16].

Travelling E. to Jurm, chief town of Badakshān, struck the Oxus at Ish-Kashim. With the mountains of Chitrāl, on his S., rising to the mighty Tirich Mir, 25,263 ft., worked up the gorge to Kila Panja, halting at Khirghiz encampments. Refusing the Wakhān R., followed the N. branch, climbing high into the frozen Pamīr. Here his journey ended at the lake of Zor, or Sir-i-Kol, which he was tempted to honour as Victoria Lake [280 n.1]. He was delighted to confirm the accuracy of Marco Polo's description of the locality [I : 70].

Rejoining Lord after an absence of three months, he then touched the Oxus on its lower course on the road to Bukhāra, whilst Lord made further enquiries about the fate of Moorcroft's party 12 years before [III, 486–7, 508].

Returning to Kābul 1–5–38 and finding that Burnes had broken off relations with Dost Muhammad, they followed him to India [426].

Wood's svys. and maps added a vast deal of geogl. knowledge about countries that were of particular interest at the time, and were quite inaccessible to European travellers for many years after. The 2nd. edn. of his account of these journeys, pub. 1872 [xix, 281, 283], contains two maps, a biog. note by his son, and a geogl. memoir on Turkistān by Henry Yule[2]. His official account of svy. Peshāwar to Kābul, dated Kābul 31–10–37, is included with the *Reports and Papers* of Burnes' mission[3].

After his rett. in 1840 Wood visited England and Scotland and was awarded Patron's Medal of RGS[4]. He then went to New Zealand on business, but was not successful. 1849, the Directors refused permission for his re-empt. by Sir Chas. Napier in Sind, and in 1852 he went to Australia for 5 years. After return to England he was in 1858 sent to Karāchi as manager of the Oriental Steam Navigation Company, which failed in attempt to run a service of steamboats on the Indus. In 1861 he became supt. of another enterprise, the Indus Steam Flotilla, till his death in 1871. "Fatigue, consequent upon a hurried journey to Simla ...at the height of the hot season, brought about his last illness[5]".

WROUGHTON, Robert [III, 516]. Ben. Inf.
b. 2–8–1797. d. Fatehgarh, 14–2–50 ; MI.

Lieut. 1–8–18 ... Maj. 29–7–48 ; inv. 31–7–49.

Son of George Wroughton, formerly EIC. attorney at Calcutta, Comdt. 3rd W. York Militia, and Diana his wife.

m., Berhampore, 31–12–19, Sophia Eliza Amelia, dau. of Col. Wright ; she d., Kensington, 9–11–80, aged 82.

Addiscombe 1813–6 ; Chatham ; selected for Engrs. but tr. to Inf. Dec. 1816.

Hodson, IV (533).

1818, Survd. Matabhānga R. [III, 15]–1821–4, rev. svy. Gorakhpur [III, 152]–1824–6, Burmese War in Arakan [III, 68–9]–1826–30, ch. Gorakhpur rev. svy. [III, 152, 160 ; IV, 223, 225].

Nov. 1830, reverted to regt. having been promoted Capt. 26–3–29.

April 1832, took up experimental rev. svy. of *pargana* Maat, Muttra Dist., which asstd. rev. svy. conference of Jan. 1833 and led to his re-appt. [213, 222, 230, 302][6].

March 1834, having completed *parganas* on left bank of Jumna, granted 5 mo. leave to hills ; "My health has of late been so wretched, and the complaint...of so obstinate a character". The surg. at Bharatpur attributed "continued ill-health...to his sojourn with the Army in Arracan in the Burmese War, and to long continued exposure to the sun from the arduous life of a surveyor. ... A visit to England can alone re-establish his health, a step...he can not resort to from family difficulties. ... If he could be allowed to proceed to Simla during the hot and rainy months, the experiment would at least confirm whether his illness rests upon mere derangement...or organic disease"[7].

On his return he survd. successively the dists. of Muttra and Agra–on left bank of Jumna only–Aligarh, part of Farrukhābād, Mainpuri, and Etāwah, his maps being beautifully executed, and his svy. of Agra described as "one of the most successful and least expensive of the whole" [214–5].

An asset of particular value to a survr. was the "medical skill for which he was remarkable".

1840, took up rev. svy. of Mirzāpur, with hdqrs. at Chunār. The villages in the hill area were so widely scattered that the svy. was more of a regular topo. svy. based on trgn. ; one of his maps shows positions of coal outcrops nr. Burdi, on Son R., Rewah, MRIO. 84 (51), [121, 228 ; pl. 14].

1842, having completed svy. to S. limits of Singrauli, took up svy. of Sohāgpur and Rāmgarh in Saugor & Nerbudda Territories to the south [228, 287].

He and Brown were by far the most experienced and capable of the NWP. rev. survrs., and both were much aggrieved at the casual terms under which their services were replaced at the disposal of the C-in-C. when the rev. were closed down, Oct. 1842[8] [7, 146, 149, 208, 233, 363, 368, 424].

Wroughton then took furl. to England. Appd., 15–12–43, to succ. Bedford as DSG. after the post had been vacant nearly 12 mo. ; assumed office on arrival from overseas, 15–3–44 ; [250, 289–90, 308, 323].

In 1844 compiled valuable note on "mode of surveying adopted in the Revenue Surveys" for the guidance of Ouchterlony in the Nilgiris ; *NWP Sel.*, III (175–84) [232 n.5].

BGO. 5–2–47, granted 2 y. leave on mc., being relieved by Henry Thuillier, and sailing from Calcutta 9–9–47 ; still unfit for duty on return, granted furl., BGO. 7–3–49 [471], but tr. to inv. est. in India.

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[1] IO. Maps II vi ; *IO. Cat.* (137). [2] Sir Henry Yule (1820–89) ; Ben. Engrs. [3] Alex. Burnes. [4] *JRGS.*, XI, 1841 (iv–xii). [5] Wood (x–xi) ; Low., II (88). [6] BTC., 3–7–32 (48). [7] letter of, 28–2–34 ; BTC., 31–3–34 (29). [8] NWP. Rev. Bd., 27–12–42.

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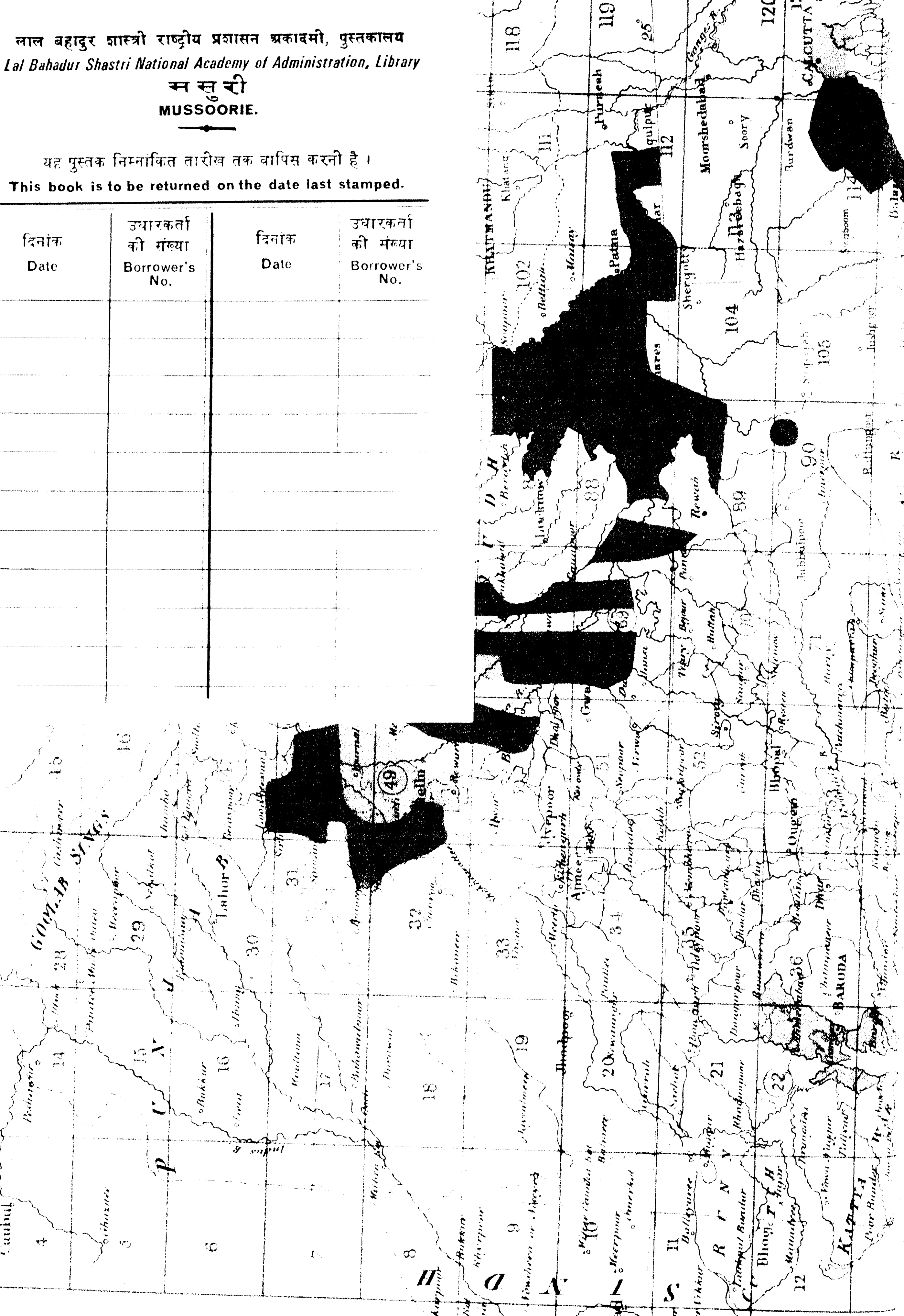

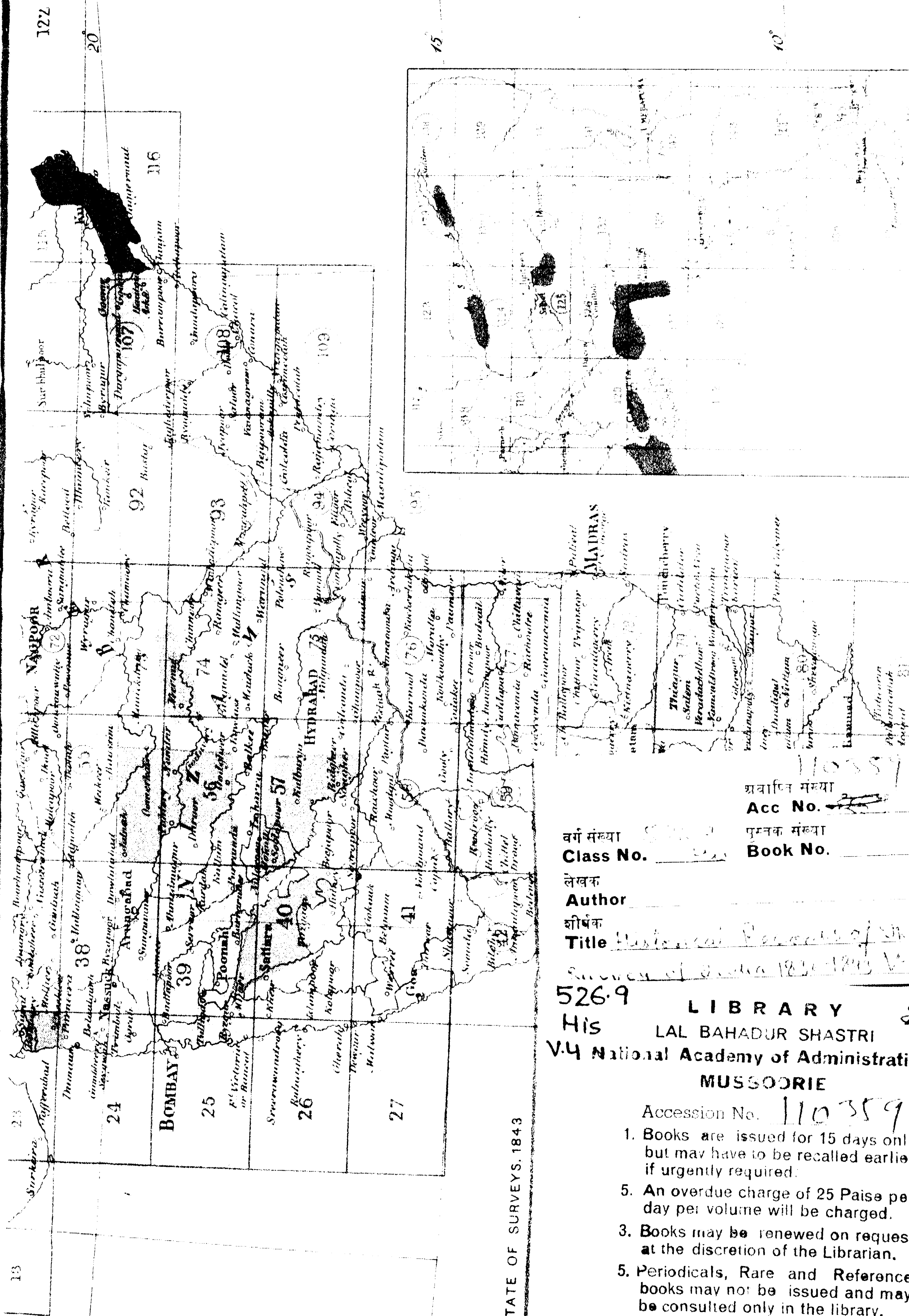

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